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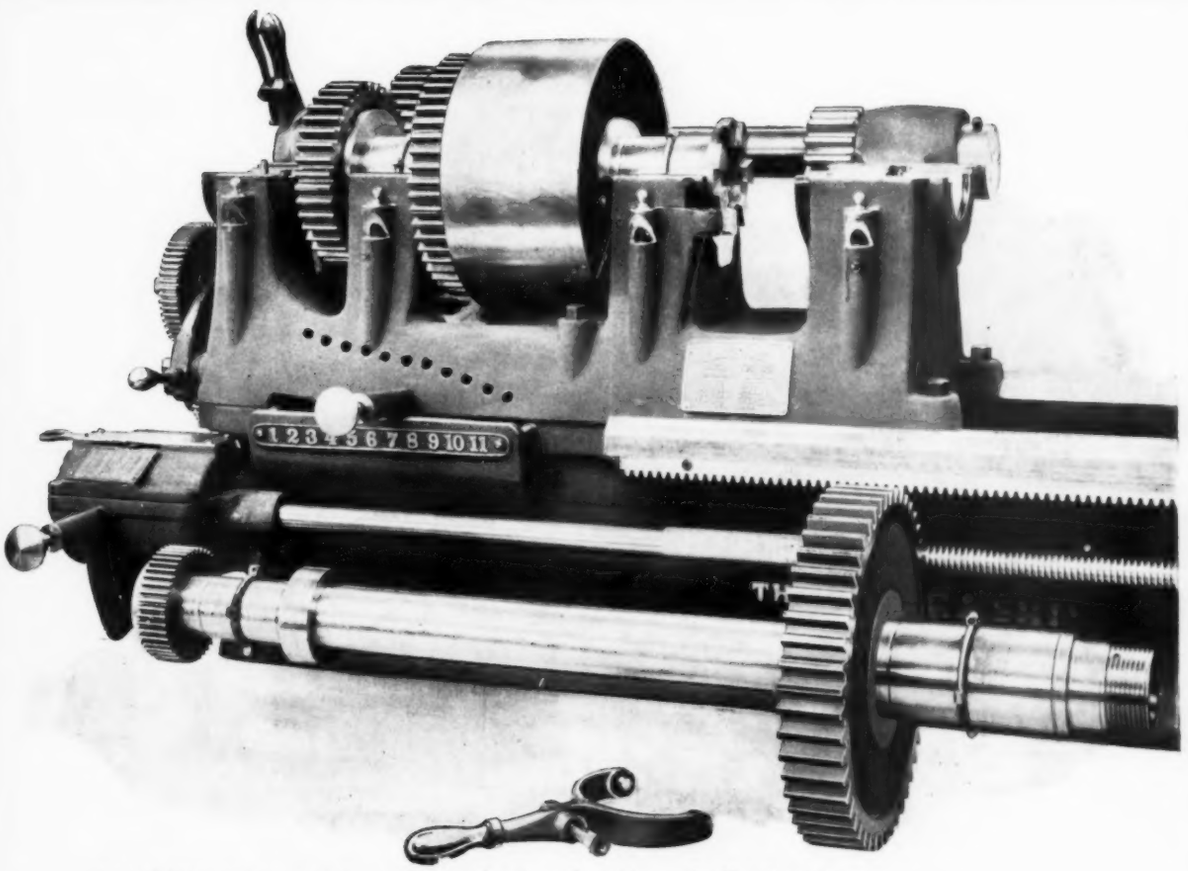

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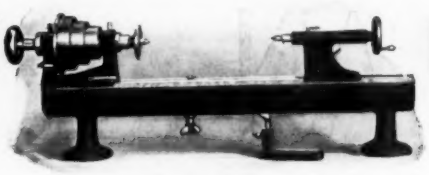

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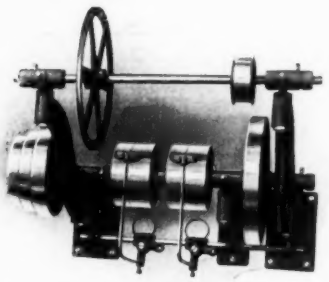

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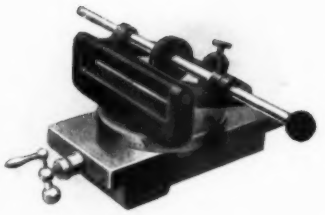

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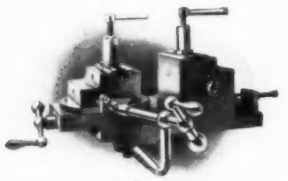

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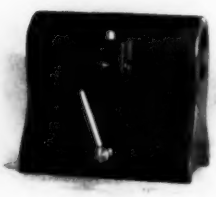

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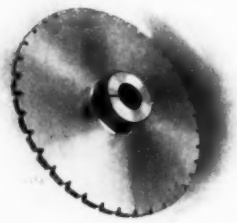

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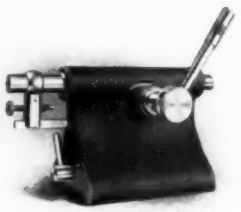

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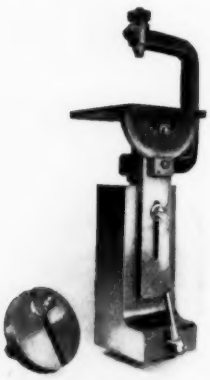

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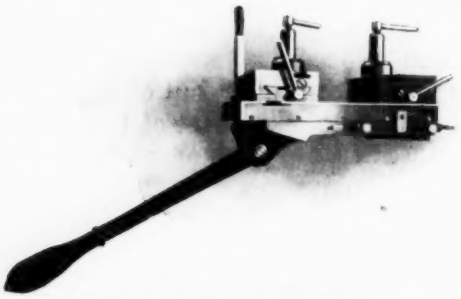

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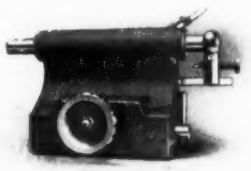

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High-Speed Steel and the Manufacture of Armor-Piercing Projectiles.

EDITORIAL CORRESPONDENCE.

The Firth-Sterling Steel Company, of Pittsburg, Pa., the maker of "Blue Chip" steel, manufactures also armor piercing projectiles; and, as these are produced from an exceedingly hard and tough alloy steel (its tensile strength being, in fact, about 150,000 pounds per square inch) they have on the spot the very best of opportunities for demonstrating the cutting qualities and testing the endurance of their high-speed steel.

Visiting the plant at Demmler (near Pittsburg) quite recently, I saw many interesting operations in connection with the manufacture of these projectiles, and also learned quite a few things respecting the handling and use of "Blue Chip" which, as might be expected, is employed pretty generally throughout the place. Therefore, in describing the processes through which the shell passes in its transition from the rough to finished state, I shall bring out a number of important facts regarding the cutting steel used in working the tough projectile stock.

First, I wish to show the proportions of a 6-inch shell, as this is the size being machined in the various operations illustrated in the half-tones. Accordingly, Fig. 1, which presents a sectional view along the shell axis, and cross-sections near the point, gives the general outside dimensions and shows the proportions of the chamber bored from the base of the shell; it reveals also the method of attaching the soft steel nose or cap, of which further mention will be made later on. As represented in the section, the projectile measures from base to point 18 inches; its diameter at the bourrelet is 5.99 inches, while the reduced portion at the rear of the bourrelet is 5.96 inches in diameter.

The material for the projectile is melted in crucibles, and a cylindrical ingot is poured, which later is worked down under the hammer until it assumes the shape represented at *A*, Fig. 2, the extra stock left at tip and base forming a means by which the blank is conveniently mounted in the lathe while undergoing turning operations. After a thorough annealing the forging is centered at the small end and placed in a heavily geared 26-inch projectile lathe, as shown in Fig. 3, a powerful four-jaw chuck gripping the base and doing the driving, while the outer or smaller end is supported by the footstock center.

Here the high-speed steel has its first opportunity to demonstrate its usefulness, the turning tool (of "hog nose," or rough-ing, form) having to remove an inch or more of metal from this toughest of forgings. This it does in two cuts, the roughing chip having a depth of about 7-16 inch and the finish 1-32 inch, the feed along the straight part of the body being in each case nearly 1-16 inch per turn. The chip is started from the cone point and a link or radius attachment at the rear of the cross-slide forces the tool toward the front as the cut proceeds, and gives the pointed

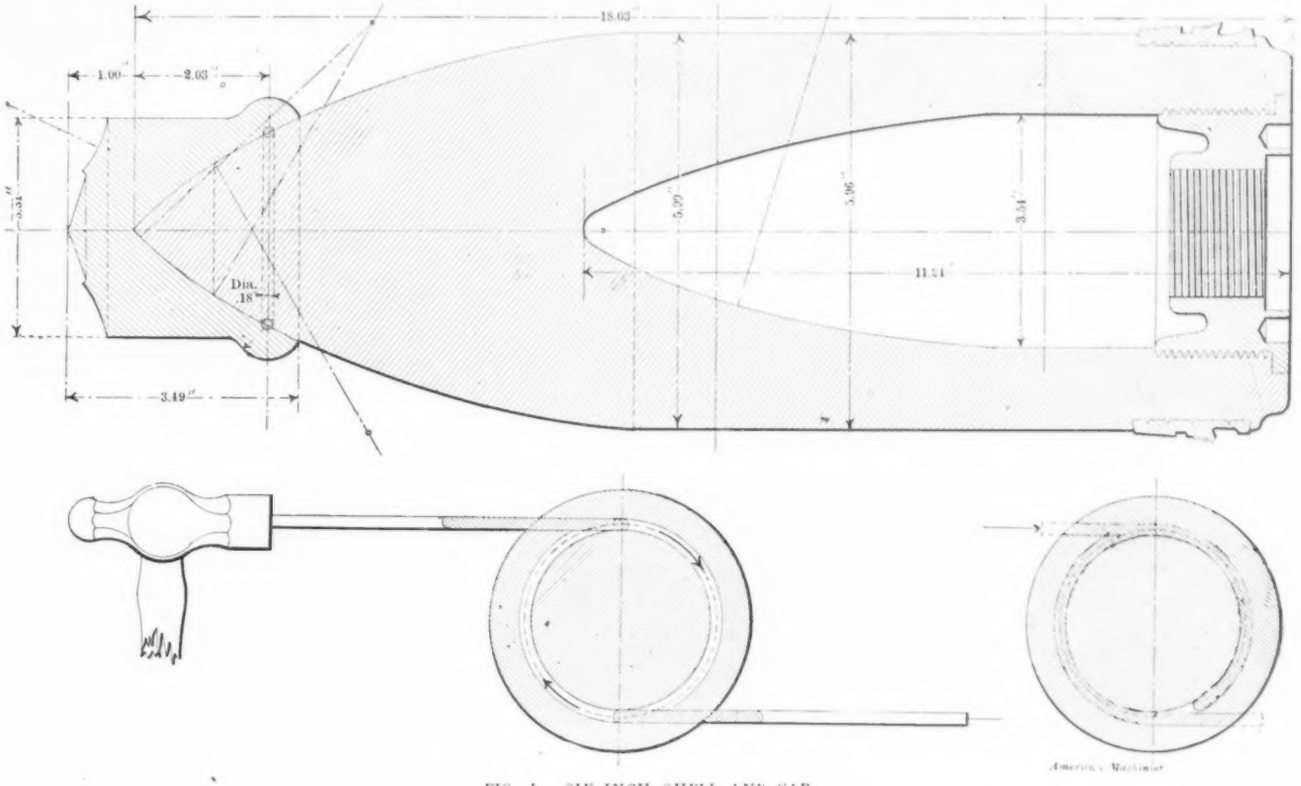


FIG. 1. SIX-INCH SHELL AND CAP.

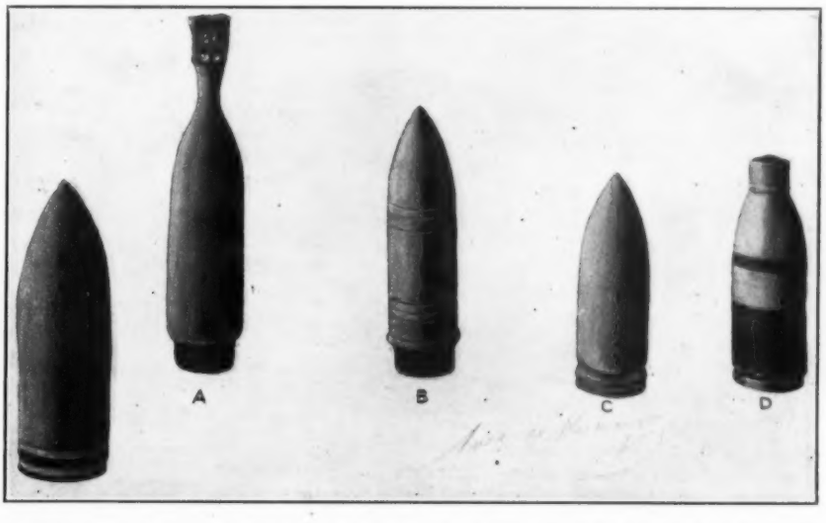


FIG. 2. EVOLUTION OF SIX-INCH PROJECTILE. EIGHT-INCH SHELL TO THE LEFT.

end the proper curvature. After completion of the roughing cut on the conical portion, the attachment is disconnected and a roughing cut taken over the cylindrical

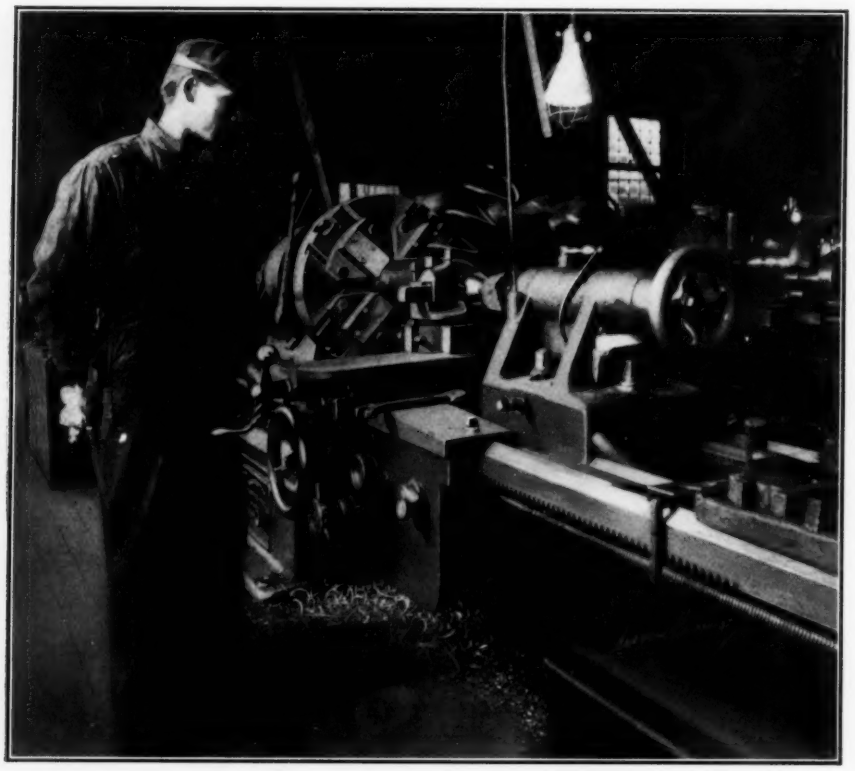


FIG. 3. ROUGHING DOWN THE SHELL FORGING.

surface of the forging. The steady rest is then set, as in Fig. 4, near the leading end of the cylindrical body, the rough tang is cut off and the point cut down for a short distance with a forming tool. A cup center in the tail spindle is next brought up to support the small end of the work, the steady-rest then being removed; the device used for operating the tool slide in roughing the cone is again attached and a finishing cut is run over the curved surface. The bourrelet is then turned down to grinding size and a final cut taken over the cylindrical body. After this operation the piece is removed to a special machine shown in Fig. 5, where it is held in a hollow rotary head which is gear driven from the rear and turns the work steadily while a tool on the cross-slide forms a groove as shown at *B*, Fig. 2, for the copper band, another tool then severing the superfluous metal at the base and leaving the forging as at *C* ready for the boring out of the chamber.

During the roughing down of the shell, as just described, the surface velocity of the work is about 45 feet per minute; the finish turning is accomplished with a speed double that, or 90 feet per minute. The removal of the tough material at this rate of speed imposes the severest of tests upon the cutting tools (ordinary carbon tools, in fact, would not stand up at all on the metal, much less machine it satisfactorily); yet the high-speed tools used stand up for shell after shell, and are often run a half-day, so I am informed, without regrinding. In fact, one of the tools I saw in use had already run for four hours, turning down several shells in that time, and was still in excellent condition.

FIG. 4. FINISHING THE POINT OF THE SHELL.

To emphasize the fact that a considerable range of temperature is permissible in heating the steel while handling these high-speed tools in the forge, two "hog-nose" or roughing tools were forged in my presence (an ordinary blacksmith's fire being used), and, after being dressed to shape, one was brought to a white heat and then cooled under an air blast; the other was heated to a very moderate temperature and allowed to cool down slowly. Both tools were ground on a dry emery wheel and ground very quickly, the business edges being sadly burned in grinding—at least the lathe tools I have been familiar with, if so treated, would be absolutely useless, so far as cutting qualities go. However, such treatment seems not to be injurious at all in the case of this modern steel. Each tool was fed across a shell forging at the speed and feed already given, and so far as could be observed both were in equally good condition at the end of the cut, the edge of neither having been dulled to any perceptible degree. I was given to understand, nevertheless, that, as a rule, the tool brought to the higher temperature would have somewhat greater powers of endurance and give rather better results than the other.

Returning now to the 6-inch shell which is all ready for chambering, we find it gripped fast in a special chuck that is carried, as in Fig. 6, on the face-plate of a boring lathe, the outer end of the work being supported by a steady-rest. Here a half dozen "Blue Chip" flat drills and boring tools—most of which may be discerned in Fig. 7—are brought one by one into service to form the chamber, which, as will be learned from the sectional view,

is about 3½ inches diameter at the outer end and 11¼ inches deep.

The tools are comparatively short affairs carried in a slot at the end of a square bar which is fed up to the work and supported in the manner indicated in Fig. 6. The first drill is shown in place in the bar to the left in Fig. 7, and a detail sketch is given in Fig. 8. The diameter at the point, as will be seen from the sketch, is 2⅝ inches, and the diameter of the enlarged portion 3¼ inches. The tit at the rear centers the tool in the holder. This drill is followed by a second tool which brings the straight portion of the chamber to size; and the roughing and finishing cone drills represented by Fig. 9, and shown also at either side of the shell in Fig. 7, remove the stock at the small end of the chamber. Then the long finishing tool in the bar at the right of the group in the photograph is run in to complete the operation in the hole. The counterboring for the base plug is accomplished by tools fitted crosswise of the bar, and the end of the shell is faced off by tools carried by the cross-slide.

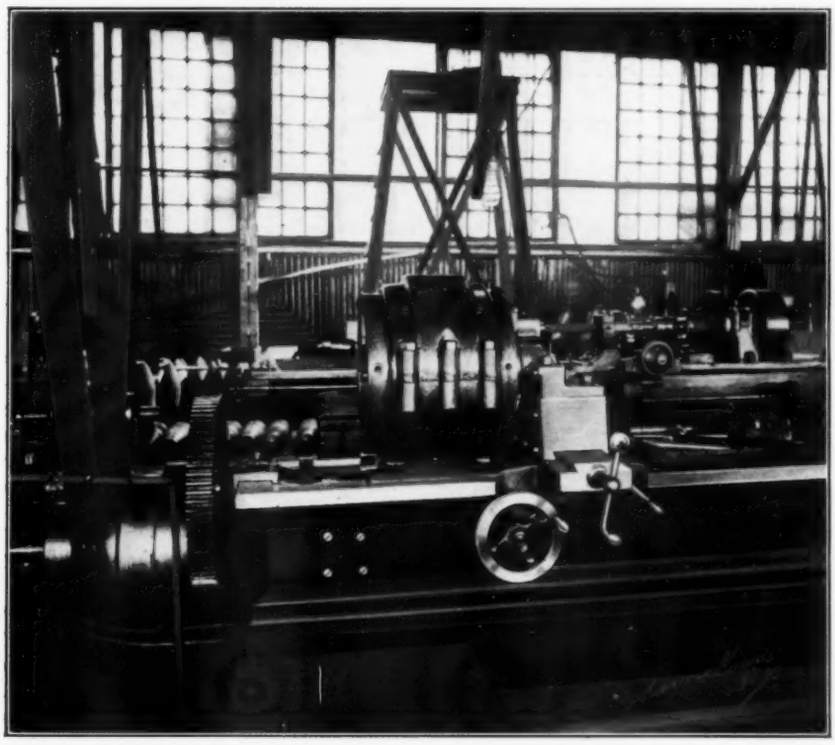


FIG. 5. CUTTING OFF THE BASE OF THE SHELL.

The first drill (3¼ inches diameter) is fed to the depth of 8 inches in a little over a half hour—or at the rate of an inch in four minutes, the work running at 35 turns per minute, and the entire chamber being finished—aside from threading for the plug—in about an hour. As may be imagined, the work and tools become very hot and a stream of water is run on the outside of the shell to keep its temperature down as far as possible. The character of the chips issuing from the bore is indicated in Fig. 6; and the drills producing these are absolutely blue—as are the chips themselves—yet they maintain their cutting edges for a remarkable length of time. As an illustration of the endurance of the drills, I wish to mention the case of one used in drilling base plugs. The material for these is an open-hearth steel of 60 to 70 point carbon, and the bars are hardened in oil and the temper then drawn until the tensile strength is about 100,000 pounds per square inch. The drill used for the 6-inch plugs is 1.31 inches diameter and the distance drilled 2⅛ inches; the speed of rotation is 352 turns per minute and the time required for each hole 1¾ minutes. From two hundred to three hundred holes are drilled before it is necessary to regrind the drill, and I am informed upon the best of authority that the drill from which these figures were obtained has been in use for five months without reforging or rehardening.

Yet these tough drills seem not at all difficult to machine: I saw one of the large curved edge chambering tools being cut down to proper thickness in the shaper and it was machined apparently as readily as any ordinary carbon tool, the cutting tool used being of "Blue Chip" stock ⅜ inch square, inserted in a tool holder. The tool undergoing shaping operations was from the regular flat stock just as shipped from the mills.

After the shell chamber is completed with the exception of the thread at the mouth, the retaining groove for the soft steel cap is formed around the nose by holding the work between chuck and cup center, and the projectile is then hardened from the nose to a point well toward the base, the latter, however, being left soft to allow the internal thread for the plug to be chased, which operation is performed with the nose of the shell gripped in a chuck and the outer end of the body backrested. Next, the copper band or rifling ring is swaged into place in its groove

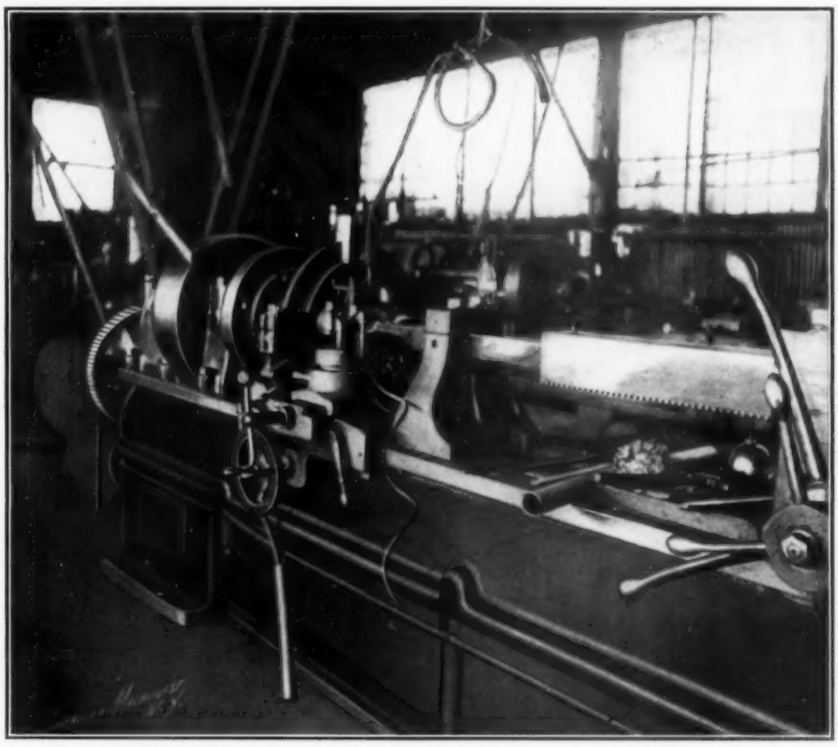


FIG. 6. BORING OUT THE CHAMBER IN THE SHELL.

which has undercut sides and longitudinal scores at the bottom to hold the copper fast; and then in the grinding lathe, Fig. 10, the bourrelet is ground to size, after which the shell is carried dead true in a lathe by chuck and cup center and the copper band turned to correct form and diameter.

In conclusion I wish to call attention to the 8-inch shell standing to the left of the group in Fig. 2. This has actually been fired through an 8-inch Krupp armor plate at the Sandy Hook proving grounds; yet in spite of this interesting performance it is uninjured so far as the eye can see, and shows no deformation whatever, either at the point or along the cylindrical body.

F. A. S.

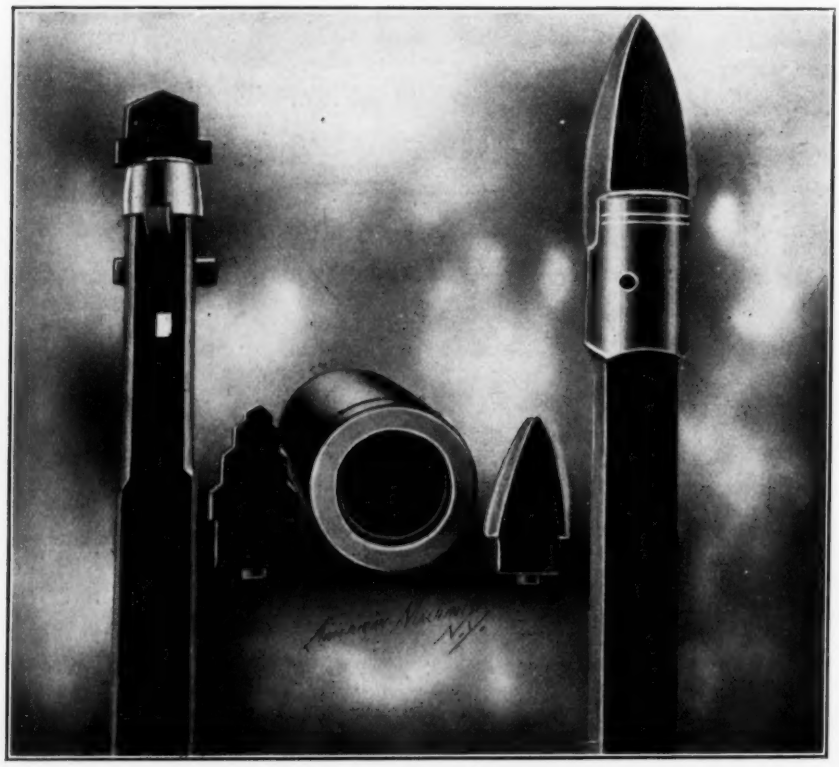


FIG. 7. A GROUP OF FLAT DRILLS AND CHAMBERING TOOLS.

With the base plug and the cap in place (these are made up from the bar) the projectile is completed—so far as machine-shop operations are concerned—and appears as represented at *D*, Fig. 2. The soft steel cap is known as a "non-detachable" and is secured by the ingenious meth-

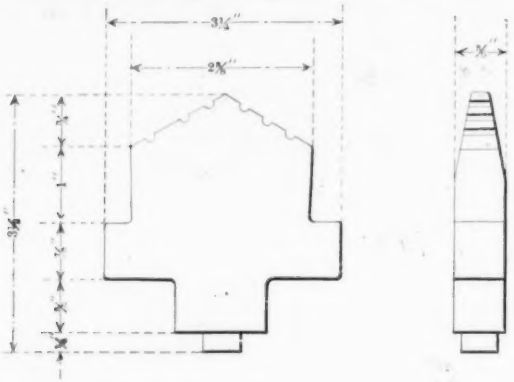


FIG. 8. 3¼-INCH ROUGHING DRILL.

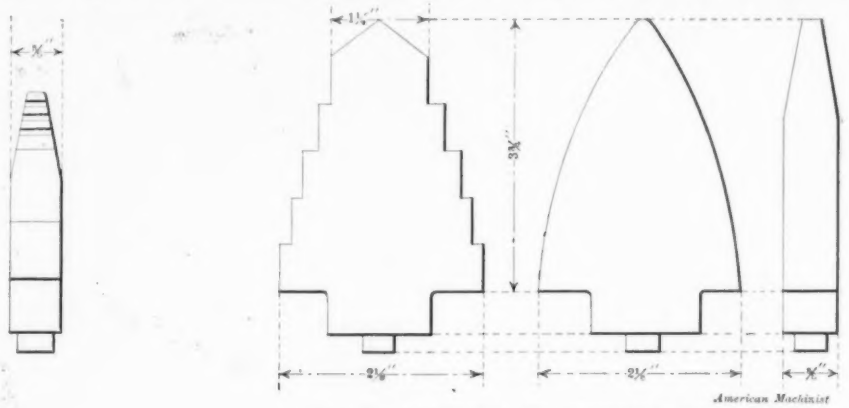


FIG. 9. ROUGHING AND FINISHING CONE DRILLS.

od illustrated in Fig. 1, which needs no explanation further than the statement that the annular groove in the cap is out of register with the groove around the projectile by about 0.010 inch, the internal groove being that much nearer the point, thus allowing the 3-16 inch rods, as they are driven in through the tangential holes, to draw the cap back firmly to the shell.

All the apprentices under twenty-one years of age of the Midvale Steel Company, Philadelphia, are to be sent to the St. Louis Exposition on a two weeks' vacation with a view to giving the future workmen a wider knowledge of what has been accomplished in structural steel and machine work. This is setting a good example.

Molding Machines and Their Use.*

BY E. H. MUMFORD.

If there is any trade under the sun to which it is impossible to adapt one single machine, or one mechanical process, it is that of molding for metal castings, from patterns as chaotic in outline and dimension as are the brains that originate them, in the one material of the universe which from Scriptural times on has been the symbol of instability and fickleness. Some things are called molding machines which almost lack the number of parts to comply with the definition. For instance, a snap flask and the usual match, with a vibrator frame and a vibrator, is the most universally applicable hand-molding machine for small work that I know; yet all that has been added to the flask and the match to make this apparatus a machine is practically one piece, which need not weigh more than six or eight pounds, so far as its operation is concerned. From this to some of the elaborate process machines which have been developed for molding specialties, the side bays of the foundry are lined with mechanisms, the mere naming of which would make a paper by itself.

In the remarks which follow I do not mean to refer to the well-known special machines which are used for molding such things as cast gears, pulleys, bath-tubs, water pipe, etc., for which the machine is built around its work, and in many instances consists largely of the patterns and their special arrangement, as in the case of a pulley machine adapted to molding pulleys ranging in size from, perhaps, 10 to 30 inches on the same machine, with every conceivable width of face in these diameters, on which the patterns represent probably two-thirds of the weight and nine-tenths of the cost of the total machine.

As I have said, the simplest hand molding machine I know is the vibrator frame, with its vibrator attached, guided in the pins of a snap flask and used in connection with a match of the ordinary description, whether of wood, metal or a litharge mixture. In such a frame any two-part pattern, which would ordinarily be molded in

*Slightly abridged. Read at the Indianapolis meeting, June, 1904, of the American Foundrymen's Association.

a snap flask, may be fitted and rammed up, cope and drag, by hand. For a flask, say 12 by 16 inches, the total weight of this machine is not more than 20 pounds, including the flasks, and the whole thing can be hung on the wall. Put this with a hand squeezer, and it is still a hand molding machine; put it with a power squeezer, and it becomes a power molding machine. Strictly speaking, the vibrator constitutes it a power machine, tho the ramming is done by hand; but in a foundry where compressed air is piped about the shop (and foundries where it is not are now exceptions), a hose to a vibrator seems hardly a power connection.

Next in point of simplicity, so far as the machine is concerned, comes the hand-ramming, stripping-plate apparatus, in which, by many varying forms of linkage, a pattern support is moved vertically, while a frame of some form supports a stripping plate through which the patterns are drawn. The mechanisms by which the patterns are manipulated and the forms and materials in which the stripping plates are made are now very numerous, and, except for the expense of the stripping plate and the necessity for attaching the patterns to separate support, there is no more generally useful molding machine made. By a slight modification in the construction of the last-mentioned hand-ramming, stripping-plate mechanism, it is possible to use the same machine for either stripping-plate or vibrator molding, according to the nature of the work. Thus a man might have a deep spur gear on such a machine in which stripping the pattern was a *sine qua non*, and the next hour he might wish to mold on the same machine a crank or a valve or a valve wheel. This could be done by attaching half a split pattern to a flat plate resting on the same support which previously carried the stripping-plate patterns, and placing on the frame, which before carried the stripping plate, a flask frame containing the guiding pins for the flask. The special construction referred to in this machine is one which differentiates vibrator machines from machines on which vibrators might be used by attaching them to one part or another of the machine, but by which attachment the flask and the mold itself would be as much agitated as the pattern which alone one wishes to affect. This construction, which is fully protected by patents, consists in an independent and elastic support for the pattern, so that this vibration does not extend to the sand, which would otherwise be more or less demoralized in the pattern drawing.

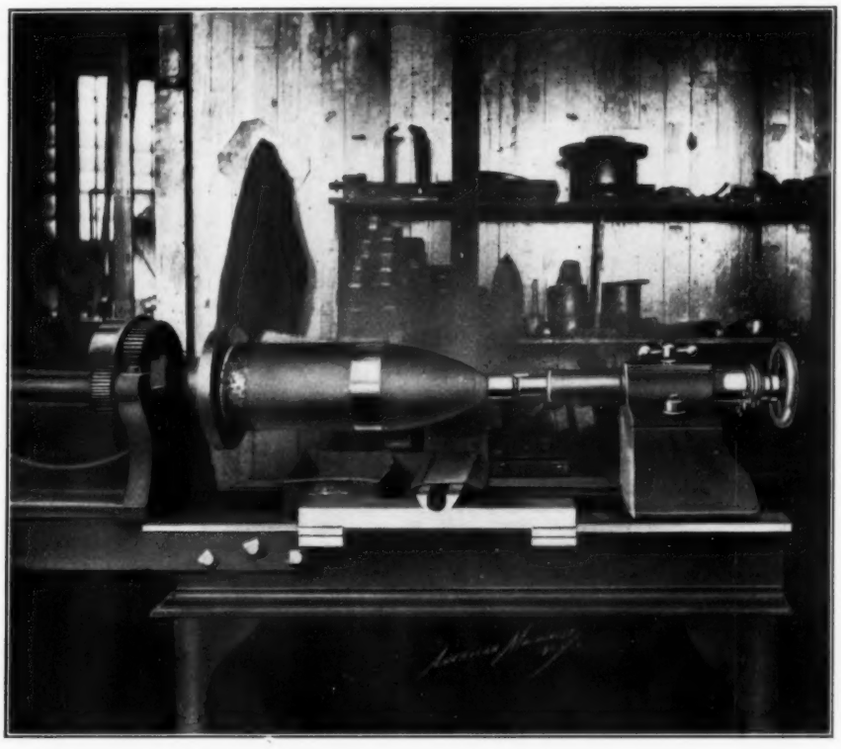


FIG. 10. GRINDING THE BOURRELET.

Perhaps, as I have begun with the simpler machines, it would be well to speak next of the squeezers, as they have been known for years. These machines are so well known and so much in evidence everywhere, and have been for so long, that it is hardly more than necessary to mention them. We have all seen the evolution, which it took years to effect, in these squeezers, changing the relatively inefficient side lever, nearly vertical in ramming, to the almost ideal horizontal lever, with which even a lazy man can make work by sitting on it. These squeezers have been fitted with auxiliary apparatus, such as stripping plates, flasks, lifters, variable tucking blocks, and sprue cutters *ad libitum*, until the hand squeezer equipment seems to have been as intelligently treated as any in the molding machine business.

It is not a far step from pulling a lever by hand to making a piston do it, and there are now forty or fifty machines in existence in which the operator "presses a button" with his hand, and rams a mold, and then presses another "button" with his knee and draws the patterns.

Not more than half the patterns in use may be economically molded by machinery without rolling the drag flask over, and stripping plate and vibrator, hand and power machines of many forms are now made to do this. When a pattern is drawn upward, there is less excuse for a stripping plate than when a pattern is drawn down, and with four powerful vibrators acting on a follow-board, deep and difficult "blind lifts" are easily made. When stripping plates are used, they may be operated by the machine or they may be left to follow the sand by gravity. Gravity stripping plates are very old, but now and then they are reinvented, much as a new house is made out of an old one by a coat of paint. If the color is sufficiently startling, you forget the old house in your amazement at the new.

It is nearly twenty years since a thoughtful foundryman jar-rammed the first mold mechanically, and it will not be long before most of the deep machine molding now being rammed by hand is jar-rammed by machine.

It is related of John Ericsson that he did not allow physicians to prescribe for him. He would use the doctor's answers to his questions to diagnose his own case. Then with the entire pharmacopeia applicable to his case symptomatically labeled by the learned man, Ericsson helped himself to his remedy. So, let me suggest that when you feel that you are suffering from what I might call mechanical prostration, you call in the open-minded practitioner with no hobby to ride and quacking no patent medicine a cure for all your ills; see what there is to choose from, and, diagnosing your own mold, make your own selection of apparatus. Regard whatever money you spend for the purchase of molding machines as only the beginning of your investment. The cost of fitting the patterns to the machines comes after that, and you should not so order your machines as to be obliged to fit your patterns in only one way, and that perhaps the most expensive and most limited in application. Anyone can buy molding machines; few use them to best advantage. Nothing is doing more to develop the mechanic in the foundry foreman than the molding machine, and the success or failure of either to-day marks the rise or fall of both in foundries which should use machines.

A gasoline fire is best extinguished with flour, sand or earth in the order named; water should not be used.

Notes From a Milling Machine Shop.

EDITORIAL CORRESPONDENCE.

HIGH-SPEED MILLING.

When one visits the shops of the Cincinnati Milling Machine Company, he expects to see something interesting in the line of high-speed milling—and there is little danger of his being disappointed. In fact, he will see there so many jobs of milling turned out with amazing rapidity under high-speed cutters and at coarse feeds that he will very likely leave the place a little bit amazed and wondering whether there really is such a thing as a limit to the possibilities of the milling machine now that cutters can be made which will stand up under speeds and feeds heretofore considered out of the question.

Just consider for a moment feeding a gray-iron strip 2 inches wide under a cutter at the rate of 27 inches per minute. A foot of table travels in 26 seconds. Yet this is the feed regularly employed by the above concern in rough milling grinder slide gibs—a lot of which I saw being machined during a visit made to their shops a little while ago.

The roughing cut is 3-32 inch deep, and the mill which is 4 inches diameter and formed with 18 teeth, has a peripheral velocity of 90 feet per minute, the feed per turn of cutter being 0.300 inch. The finishing cut is taken with a face mill, a Walker magnetic chuck holding the work and the mill removing 0.010 inch of stock, the feed being 10 inches per minute, or 0.200 inch per turn of cutter. Gibs 1 inch in width are held five at a time by the magnetic chuck and finished simultaneously, the table having the same rate of feed as with the 2-inch gib.

The roughing operation is performed on a Cincinnati No. 3 plain miller, and the finishing on a No. 2 machine fitted with vertical spindle attachment; the cutters are of "Novo" steel, and the work as it leaves the second machine has a surface requiring little more than the removing of the loose iron to put it into shape for service.

Another interesting job of milling with high-speed cutters is a gray-iron cover plate, 4x6 inches, which, when finished, is fitted to the knee of the miller itself and slides back and forth as the table is fed in and out. This plate is held in a vise (there are two on the table) and fed under a spiral tooth slabbing cutter at the rate of 10.7 inches per minute, or 0.210 inch per turn of cutter; the latter, which has 16 teeth and is 3 inches diameter, running at 51 turns per minute and removing ⅛ inch of metal. While the cutter is operating on one plate a second casting is clamped in the other vise and then milled while the machined plate is removed, the work thus being handled very expeditiously.

With cutters from high-speed steel the time required for milling T-slots in the miller tables is also greatly reduced. Take, for example, one of the tables, which is 39 inches long and has three T-slots finished with a 1 1-16x½-inch stem cutter (formed with 8 teeth), the vertical cut from the face of the table having been formed at the same time that the top of the table was slabbed off. I saw such tables T-slotted in 18 minutes each (and this is kept up day after day), this including the time required to lift the work in place with an air hoist, secure it on a fixture, adjust the knee for each cut, and, after completion, to remove the work from the miller. The actual time consumed in the milling, at one cut, of each of these three cross slots is very little over three minutes, the table travel being about 12 inches per minute. An air blast is of course used to keep the cutter free from chips.

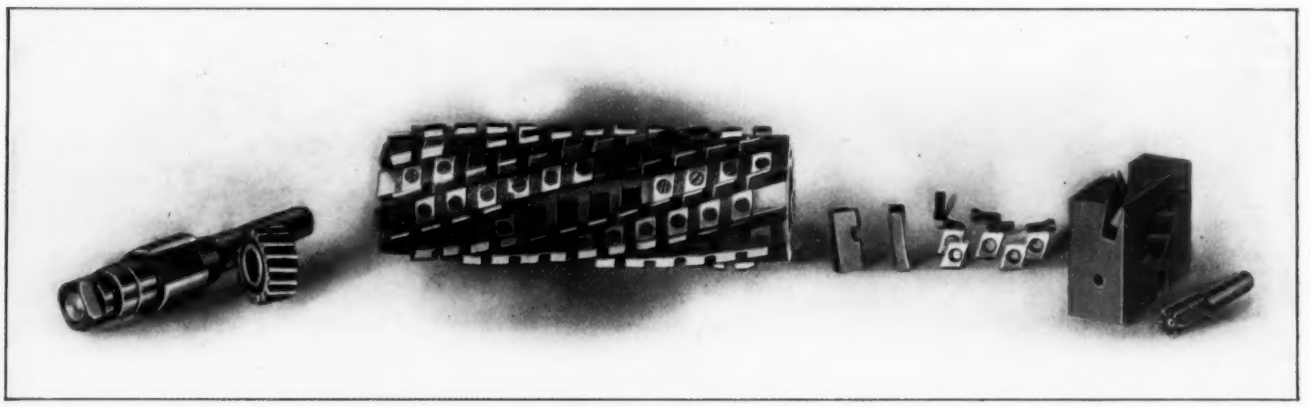


FIG. 1. AN INSERTED TOOTH MILLING CUTTER.

AN INSERTED TOOTH CUTTER.

A novel milling cutter just completed at the time of my visit and which should interest all toolmakers, is shown in Fig. 1, together with some tools employed in its construction. The cutter is 12 inches long by 4½ inches diameter and the inserted teeth, which are of high-speed steel, are put in in sections, each piece having a length of about 2 inches.

The steel body or hub was first provided with a series of spiral slots ⅜ inch wide, and milled from end to end. The staggered pockets between the slots were then butt milled to receive the short clamps which hold the blades in place. Several of the clamps are shown to the right of the cutter, while in the body itself will be noticed the pockets from which these clamping members have been removed. These small steel pieces were cut off at an angle and a little longer than finished length from the milled strip, were drilled and counterbored for the binding screws and then fastened in the pockets, the body having already been drilled and tapped for the screws. A lathe cut was then taken over the clamps to bring them to the diameter of the cutter body, and the latter was again mounted between the spiral head and footstock centers in the miller and a shank mill again passed through each helical slot, thus dressing off the ends of the clamps and giving them a surface corresponding to the sides of the slots.

The cutter teeth, after being severed from the bar, were milled on sides and edge to suit their seats by means of the special arbor shown to the left and the fixture to the right of the cutter. The tooth blank was dropped in the slot in the long collar on the arbor and held there securely by clamp collars, which seized the ends of the blank when the nut was tightened. The arbor was held between the milling machine centers, and with the head geared to the spiral of the cuts in the cutter body one side of each blank was milled to this same spiral. The blanks were then clamped the other side up in the holder and the other face finished in the same way. The holder in which the blanks were secured while milling the edges was provided with a slot to receive the milled pieces, and by a screw adapted to hold the work tight. Centers were provided at the ends of the fixture (and at the right distance from the bottom of the slot) and a special driver attached at one end so that the holder could be mounted and driven between the miller centers. The upper edge of the cutter blade was then easily milled winding and to the correct clearance angle; and by means of a slender mill reaching through an opening in the fixture the bottom was milled to conform to the bottom of the grooves in the cutter body. The ends of the blanks were cut

to the correct angle and the grooves for breaking up the chip milled by holding the work in the milling machine vise.

The clamping pieces before being hardened were dressed off slightly on the bottom so that when drawn down by their screw they would wedge tightly against the cutter blades and hold them fast. After the blades were fitted in place a light cut was taken over their edges in the lathe; then all parts with the exception of the body were hardened. After reassembling, the cutter was of course finished in the grinding machine.

A TRUCK FOR MILLER TABLES.

The shop truck illustrated in Fig 2 is a handy affair used in the milling machine erecting department and adapted especially for handling miller tables. So far as the lower part is concerned, it is a regular Towsley shop truck; the upper part, however, is a framework carrying three rollers

FIG. 2. A TRUCK FOR MILLER TABLES.

which are mounted on shafts having eccentric journals, and by means of the lever at the ends of these shafts the latter may be turned to lift the rollers slightly above the upper platform or to drop them below its surface. Thus a miller table may be easily rolled on to the truck and then, by turning the levers, dropped on to the wood top. When a table is to be placed in its saddle on a miller in the process of erection, the truck is backed up to the machine, the work elevated by the rollers, the knee dropped to right hight, and the table which is already thoroughly cleaned with gasoline, slid easily and quickly into position. F. A. S.

In a blacksmith shop at Wilmington, Del., recently, a helper was swinging a sledge when it flew off the handle and struck a man in the back, knocking him down and injuring him seriously.

Echoes From the Oil Country—Getting Ready Before the Job Comes—Education as Preparation.

I do not think that anyone will accuse me of having a bias in favor of the technically trained school man as against the practically trained shop man for machine shop use. I was not exactly born in a machine shop, but my working life has been spent there, and I am better acquainted with the men that work there than I am with any other class of people in the world. From this it can be readily understood that my sympathies are naturally and properly with them. I have the faith in their integrity and in their ability which comes from a close and intimate friendship and knowledge.

My knowledge of the technically trained man has not been extensive, and, as applied to the shop, it has not been as pleasant. Perhaps it has not been under conditions that showed me his best side, but it is none the less true that he does not seem to slide into his place in the shop with as little friction as does the practically trained man.

It may be as well for me to say that by the technically trained man I mean the one who begins his shop career after he has received his technical education. Many a man who gets such an education because of the needs of his shop work carries it so modestly that often he is not suspected of having it, and people wonder how he is able to keep at the front as he does.

While I am in favor of giving the shop man the advantage of all the opportunities that come up in the shop, in the way of advanced jobs with better pay, yet it is plain that without education there is a limit to the advancement possible for him, no matter how favorable those in authority may feel toward him.

When I sat and listened to the address of President Dodge, at last winter's meeting of the American Society of Mechanical Engineers, on "The Money Value of Technical Training" (printed at page 1728, Vol. 26, of the AMERICAN MACHINIST), I was wondering how much of the value of that education, as shown by him, came from the original quality of the material and how much was due entirely to the work on that material.

I have no reason to doubt the accuracy of the conclusions reached in that address, and yet I am very far from willing to accept the logical conclusions that would appear to come from them. While the result of that education was to enable the men who had it to earn much more than the men who did not have it, it does not necessarily follow that this latter class would have been equal to the others, even if they had been put through the same process of education, nor that the first class would not have been above the average even without the benefits of the education.

You see I am somewhat a believer in things having a tendency to find their natural places if free to do so, and I do not think that men are an exception to the rule.

If others have given that address the thought that I have, it is the most thought of of anything that was offered at the meeting, not even excepting the wonderful display of Thermit; and when thought is once aroused it is remarkable how many things seem to relate to the subject. While much is written about the cash value of men of one kind and another to someone else, there does not seem to be so much on the subject of the value to the man himself.

Yes, I have read what Mr. Richards has said about piece work and have followed Messrs. Halsey, Taylor, Gantt, Orcott, Rowan, Walker, Emerson and others in their explanations about the premium systems in their various forms, and I believe they are all right under the proper conditions, but this is not the phase of the subject that I wish to call attention to.

I do not think that Mr. Dodge or anyone else would have us believe that a technical graduate has such an increased earning power because he can run a lathe, drill press or boring machine so much better than a shop-trained man, and if this is the case then his power must come instead from his ability to fill wants that the shop-trained man does not fill.

Recognizing that he must fill such wants or he would not find anyone to pay him the increased price, I have tried to find out how many of these wants absolutely require technical knowledge and training and how many of them are filled by qualifications which, while they are generally found with the technical training, are not

directly a part and could be acquired without it.

A mechanical friend handed me a little paper-covered book, entitled "Top or Bottom—Which?" which I wish could be read by every man in this country, or rather by every boy who some day expects to be a man.

While it does not go into definite values in dollars and cents, it is a powerful representation of the cash value of good habits, of careful thinking, of good manners, of trustworthiness, of keeping good company, of mental industry, of force of character. Surely these things are not the birthright of the technically educated man to the exclusion of the one who is not so educated. His education, and his surroundings while receiving it, may impress him with their value, and train him up in their use; but that is the extent of his advantages in that line.

I was calling on the manager of a works employing a large number of skilled workmen of various kinds. He had worked up from being a machinist, until he had reached his present position, and I found that he still thought it necessary to keep on studying, and I also found that he was very much interested in this very subject.

"How do you go at a what may seem to you promising subject to wake him to a realizing sense of the opportunities by which he is surrounded?" he asked.

I explained as best I could some of my efforts in that line, and wanted to know how he did it, and also how he picked out the likely one.

"Whenever I see a fellow that is a little ahead of his surroundings I keep my eye on him. If he came from a better shop to mine and seems to gradually sink down to the level of the worst of his surroundings, I may try to jar him up a little, but I do not think it is of much use for me to waste time on him. If he came from a worse shop and I know it, and I find him taking up with the best in mine, then I try to see if there is not something still better in him," he said, and he continued: "I will give you an illustration of one of my recent efforts. I have a young fellow working in the foundry. From what I had known of him I did not expect much of him, but he attracted my attention by the fact that he was doing much better than I had expected he could do. He was a rough young fellow without much education, but he was cheerful, and seemed to want to learn, and the results of his efforts showed that he had good judgment.

"One day I took a chance to call him to one side and went after him somewhat after this style: 'Tom, I have been noticing you and your work for some time back, and I think you have some pretty good stuff in you if you care to make the best of it. Perhaps you think that when you get to be a first-class molder you will be well up in the world, but why not aim a little higher? Ten, fifteen or twenty years from now us fellows that are foremen and superintendents will be gone, and someone will have to do the work then that we are doing now. We were getting ready years ago for the places that we fill now, and the ones that are getting ready now will be the ones that will fill our places. You don't need to be afraid that you won't be wanted if you are ready. You may look at me, or at some foremen that you know, and wonder how we hold our jobs. Just look around among the men and think whether there are any among them that you think are better qualified to hold the jobs. Think over the reasons why you would not put certain ones in if you owned the shop, and it will show you some things to keep away from. If you want to climb up, I am willing to give you any pointers I can to help you.' Tom said he would like to know what to do to help himself along, and this is the advice that I gave him, and I want your opinion on it." Being assured that I would tell him what I thought of it, no matter what it was, he continued: "Don't be bashful about it if you don't happen to agree with me. I feel that this subject is of at least as much importance to the general machine shop business as high-speed steels or automatic machinery, or the premium system, or new machine designs, or any other thing that is before us to-day. After all is said and done, your shop or mine is not a bit better than the men who work in it. Some shops can supply all the foremen they need for their own work and have one to spare once in a while, while other shops never grow one. But, to get back to Tom. I said: 'I know you did not get much schooling, and I would advise you to do a little studying. Don't try to take too much at once. You have lots of time if you just keep moving all the time. Arithmetic and grammar will be enough for a start. Be sure to get a teacher. You will be able to learn a whole lot that is not in the books by bumping up against a teacher regularly. And there is one thing more, Tom; go to church. I don't want to proselyte you, and won't mention any church; only, go to one where nice people go. It rests with you whether your head will be sticking up above the crowd when someone is looking for foreman timber, or whether you are down in a rat hole somewhere. If you are taller than the fellows that are around, you need not be afraid of not being seen. You can't fail to see a six-foot-two man in a five-foot-six crowd.' Now, what do you think of that for advice to a fellow starting in in the foundry?"

"I don't intend to try to improve on it," I answered. "Just viewed from a utilitarian standpoint I think it is all right."

"I was not sure that you would fall in with my ideas in regard to studying grammar and going to church," he remarked.

"The idea is very clearly set forth, although I never had thought of it so compactly before. We both know men who are good mechanics, but who have never learned to express their ideas, and have seen them surpassed by those who could talk better although much inferior, judged as mechanics only. Grammar is only the art of speaking and of writing the language correctly. I think the advice to go to church speaks for itself. Very few men would turn a man down because they chanced to meet him often in church. The same cannot be said of every place where men meet and are seen."

That those in authority are continually on the watch for a head that is sticking up, the following will show. It was told to me by the assistant superintendent of one of the best known lathe works of this country, and it tells of a little experience of his when he was working in the shop as a machine hand. I will draw the picture as his telling left it in my mind. A discussion as to shop methods, etc., had led up to it.

"It happened this way," said he. "The son of one of the owners, a young man fresh from college, had come into the shop to get practical shop experience to enable him to run the business. It was generally understood that some day the business would be his. He was a smart young man, but there was one thing that he did dislike to do, and that was to keep his machine clean. You couldn't blame the foreman for not going after him very strong about it, nor the superintendent for not appearing to notice it, but he certainly did have by all odds the dirtiest machine in the entire place. If any of the rest of us had let our machines go like he did we would have had to look for another job in short order. One day he was absent and a hurry job was wanted from his lathe. Some special fixtures were fitted to that lathe, so that it was the only one that it was convenient to do the job on. I was told to take the lathe and do the job.

"As I always tried to keep my machine in first-class shape, it made me mad to have to go to a machine that was so dirty. There was nothing for it, however, but to do as I was told; so I took a brush and began to brush away the chips and dirt to make sure that I had all of the lathe there. As I was at work the superintendent came walking down through the shop and stopped and stood looking at me. I imagined that he was impatient because I had not jumped at the hurry job fast enough, but was too mad to care what he thought. After brushing off all the dirt that I could, I took some waste and went over the entire machine with that.

"While the superintendent did not watch me all the time, it seemed to me that his eye was on me no matter what part of the shop he chanced to be in, and a number of times he stood where there

could be no mistaking the fact that he was watching me. The more I was convinced that he was watching me the madder I got. The only reason I could think of for the interest he was showing was the fact that I was using so much time to clean that machine; but I made up my mind that it would have at least one good cleaning, job or no job, unless he came up and said something. Not content with wiping it off, I got some gasoline and cut off all the old grease, saw that the oil holes were free, and flushed out all the bearings, ran the carriages back and forth and in and out, and did all the cleaning that I could do without tearing the machine to pieces. When I had done all I could find any excuse for doing I set up the machine and did the job, and after cleaning it up properly I went back to my own machine. I was not yet in any too good a humor, for the superintendent had evidently had his eye on me through it all, although he did not say anything or come close enough to encourage me to say anything.

"Soon I saw him coming my way, and thought that I was in for it; but I made up my mind that I would let him know what I thought about letting a machine get into that shape. As he reached me he said, 'What pay are you getting?' I had received notice a few days before that from the last pay day I should receive an increase, and I answered, "From last pay day I get $2.80 a day,' and wondered what that had to do with it. I was not kept long in doubt. 'From last pay day you get $3 a day,' and having said that he walked away. I know now that it was the thoroughness with which I did a much needed job that attracted his attention."

Now this same man is on the lookout for "surface indications" himself, and he is only one of many. W. OSBORNE.

Horace Lee Washington, United States Consul at Geneva, Switzerland, calls attention in *Consular Reports* to a style of ticket issued by the Swiss railways which would be highly appreciated in this country if they were possible here, which probably they are not. These tickets, good upon most of the railways and the lake steamers throughout Switzerland, enable the holder to travel at will without limit as to mileage or line traversed for a stated period of time, usually fifteen or thirty days. The tickets are obtainable at all large railway stations and may be ordered through any station. The rates of fare are:

Limit.	First class.	Second class.	Third class.
For 15 days.....	$14.50	$10.61	$7.72
For 30 days.....	22.19	15.44	11.58

Upon these rates 96.5 cents is reimbursed at the end of the period. No baggage is carried free on Swiss railroads. Trunks may be sent by mail and are delivered at hotels or elsewhere, but are not collected for transmission.

Liability of Manufacturer for Latent Defects.

BY HENRY KLEIN, LL.B.

Manufacturers are frequently called upon to respond in damages for shortcomings in the goods they put upon the market, and they perhaps feel that a better understanding of the law defining their rights and liabilities would enable them to prevent losses. A terse and concise statement of the law on this subject should therefore prove of interest.

A warranty is an agreement between the buyer and the seller, whereby the seller guarantees the existence of a certain fact in regard to the article sold. There are two kinds of warranties: express and implied. An express warranty is one that is particularly mentioned at the time of the transaction; an implied warranty is one that the law presumes as existing sometimes from the nature of the contract, sometimes from the article that is the subject of the sale. Thus, in the sale of personal property, the law implies a warranty of title; that is, the seller guarantees that he is the owner of the article he undertakes to sell.

There is a doctrine in the common law, known as the doctrine of *caveat emptor*, which, translated into English, means "the purchaser beware." By this doctrine the purchaser of goods is required to be on the lookout for defects; it does not permit the seller to misrepresent the quality of the goods, but neither does it require him to disclose the defects if any exist. Thus, if A buys a horse of B and there is nothing said as to its soundness, if the horse turn out to be unsound, the seller is not liable. The doctrine of *caveat emptor* makes it the duty of the buyer to examine before he buys, and if he does not care to do so, or if he happens to lack knowledge of the goods he is buying, he can protect himself by exacting a warranty from the seller. If that is done and the goods turn out to be defective, then the seller is liable for the defect.

To this rule of *caveat emptor* various exceptions have been established, and one of these exceptions is where a consumer buys goods from a manufacturer. If A, a customer, goes to B, a manufacturer, and orders goods, specifying that they are to be used for a certain purpose, and B is aware of the fact that A relies on B's knowledge of the goods, the law implies a warranty by B that the goods are fit for the purpose intended; that is, by accepting the order under such circumstances, even tho he does not in so many words agree that the goods shall be fit for the purpose for which A requires them, B becomes under obligations to supply the goods, and if it turns out that there is a defect in them, B is liable. The law is the same where the article produced by the manufacturer is kept in stock by him or is made to order. The reason of the rule as given by the courts is that the manufacturer is in a better position to know whether his goods are fit for the purpose for which they are intended than the purchaser; and that if there are any latent defects he is more likely to know of them than the buyer, and is the one that could have guarded against them. The law therefore imposes upon him the duty of disclosing the defects if any exist, or in default thereof paying damages to the party injured. The courts hold that it is unreasonable to suppose that persons buying goods from a manufacturer will rely upon their own knowledge only.

The manufacturer in selling an article for a purpose known to him impliedly warrants against latent defects growing out of the process of manufacture; on the other hand, he is not liable for latent defects unknown to him which arose through lack of skill of some previous manufacturer without his fault, or for latent defects not discovered by him, which resulted from defective materials furnished by others.

It should be stated by way of explanation that the common law, of which the doctrine of *caveat emptor* is a rule, owes its origin to customs and usages; that it grew up in England and was brought over to America by the Pilgrim Fathers; that it has since been modified by various decisions and that the law in one State might be slightly different in a given case from what it would be in another; that the principles laid down herein are the law only where there have been no statutory modifications of them; that the statutes on the subject are very few, and that the principles laid down herein may be said to be the law in the majority of the States of the United States.

The courts have held that warranties that the articles were fit for the purposes intended were implied in the following goods: Machinery of all kinds, harvesters, potato diggers, corn cutters, mining pumps, wind mills, furnaces, stationary engines, clothing, copper sheathing, hair restorers, barrels, barges, packing boxes, building materials, iron and spirituous liquors.

The manufacturer is not liable where the article to be manufactured is known, described and defined, altho stated to be required for a particular purpose; thus, if a railroad should order a particular kind of rail for its road, and the manufacturer produces a rail that is made in accordance with the specifications, he is not liable if for instance the rail should prove too light for the traffic it is put to, even tho the railroad should state how heavy a burden the rail would have to bear. The railroad in this case relies upon its own knowledge and not upon that of the manufacturer.

The doctrine of implied warranty where the manufacturer sells to the consumer has also been extended to cases where the sale was made to a dealer; in such a case the implied warranty would be that the article sold shall be reasonably fit for the purpose for which it is made. Where one manufacturer sells to another, the latter buying

the goods to use in another manufactured product, of which it is a material, he impliedly warrants that it shall be reasonably fit for such material.

Kingston, N. Y.

To Make Iron Chill or Soft.

A correspondent wishes to know what mineral may be added to iron in the crucible, when casting, to make the iron chill, also what mineral may be put into the melted iron to make it soft. Referring this question to W. J. Keep, of Detroit, he replies as follows:

"Probably instead of 'crucible' is meant cupola. Chill is governed by silicon. Use old car-wheel scrap, or else reduce silicon until the required chill is obtained. To make iron soft, add silicon until the required softness is obtained. Pig iron can be purchased containing the required silicon, or iron that does not contain enough can be mixed with iron that contains more than enough, to make the average right."

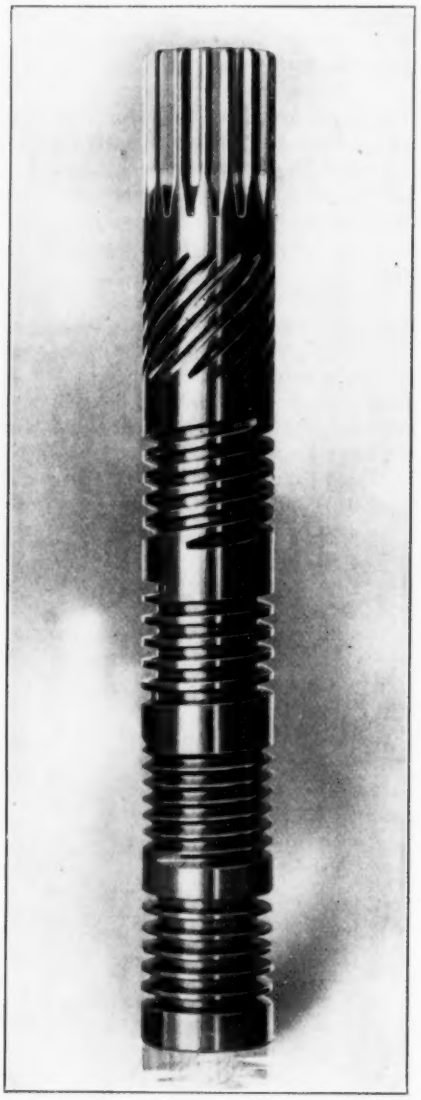


FIG. 1. SOME THREAD MILLER CUTS.

Thread Milling Machine Work—Thread Milling Cutter Grinders.

EDITORIAL CORRESPONDENCE.

If one would see something interesting and instructive in the line of threading operations, let him visit the thread milling department at the Pratt & Whitney shops and watch the wide variety of work handled by the group of machines in that department. In one thread miller he will see lead screws cut (and within limits of error of 0.001 inch per foot) and in another he will find lathe and screw machine spindle-nose threads being milled; while other machines are attending to the milling of worms, the production of threads on short studs, the cutting of right- and left-hand chuck screws, etc. For, work of all sorts requiring accurate threading, if within the capacity of the machines, is turned over to the thread milling department. And even such short threads as those required at the rear end of spindles, and such small and accurate parts as bench-lathe cross-feed and compound-rest screws, which are about 8 inches long by 5-16 inch diameter, are cut on the millers.

The versatility of the thread milling machine and its consequent adaptability to miscellaneous work and to pieces of unusual character, as well as to standard parts made in large quantities, is perhaps best illustrated by the engravings, Figs. 1, 2 and 3. The first of these represents a steel specimen 2 inches diameter by 15 inches long, with a circular rack formed at one end, a spur pinion at the other, and between the two a United States standard thread, an Acme standard thread, a worm, and a 45-degree spiral gear. In cutting the circular rack the cutter arbor was set horizontally and the change gear bracket was dropped, the lead screw being turned through the medium of an index wheel to move the carriage along for each cut a distance equal to the linear pitch of the rack. In the case of the spur gear the cutter head was set with the arbor in a vertical position and fed by driving direct on the lead screw, the change gearing leading to the spindle being disconnected and the indexing accomplished through the regular index ring on the spindle.

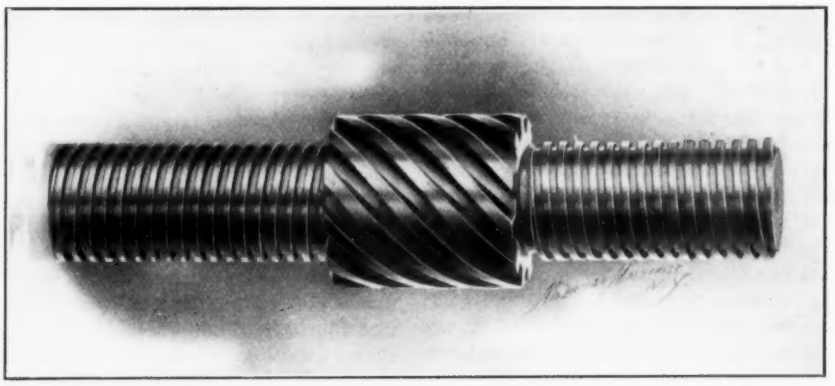


FIG. 2. DOUBLE THREAD RIGHT AND LEFT HAND SCREW WITH SPIRAL PINION CUT IN THREAD MILLER.

Another interesting piece of work is depicted in Fig. 2, which represents a double thread, right- and left-hand screw, with a spiral pinion near the middle, the diameter of the threaded ends being 1 1-16 inches and the thread 8 per inch Acme standard. The 45-degree spiral pinion is 1.296 inches pitch diameter, 2 inches face, and has eleven teeth. The total length of the piece is 6 inches; and six such parts were cut in a little over three hours, the time given including the setting up of the job.

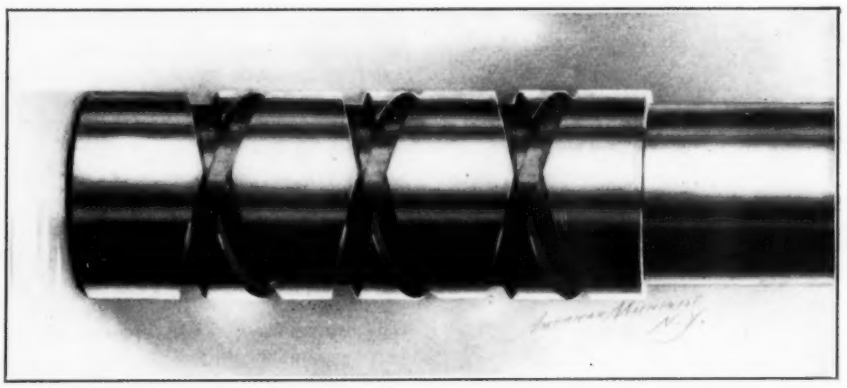


FIG. 3. A THREAD MILLER JOB WITH INTERSECTING RIGHT AND LEFT HAND GROOVES.

The piece in Fig. 3 has right- and left-hand helical grooves crossing each other as shown, and forming a particularly awkward job to handle in a lathe, as the tool must necessarily jump upon reaching each

point of intersection, thus making it practically impossible to secure a clean, sharp angle at the intersecting points. The thread miller, however, handles such work as easily and satisfactorily as it does ordinary threads, grooves of the character

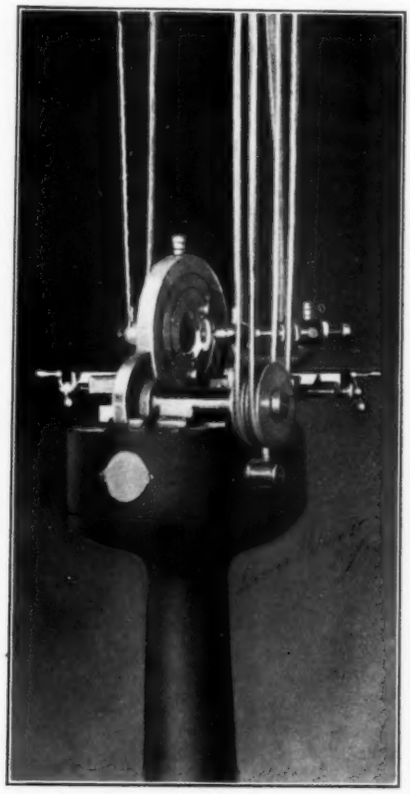


FIG. 4. MACHINE FOR GRINDING SIDES OF THREAD MILLING CUTTERS.

represented being milled at the rate of 4 inches per minute, measured along the helix.

In finishing the cutters used on the thread milling machines some highly interesting grinding machines are employed. The first of these is shown in Fig. 4, where both sides of the cutter body are

into a chuck open at either side as represented, and is held there centrally by tightening lightly one of three clamps bearing against the sides of the teeth. The chuck is geared from a shaft driven by round belts, and at either side is a wheel spindle mounted in a head which is adjustable on a base set at an angle to the work axis. Either spindle head may be independently adjusted to bring the wheel to the work and both wheels when started up pass in and out across the cutter sides until a

form a seat for the cutter, three similar pins being carried by the clamp plate. Air under pressure and admitted through connection *g* passes through the hollow drawing-in rod *h* and then through three passages *i* reaches the rear of the pistons and forces them back, operating clamp disk *d* and causing it to hold the cutter until the latter is ground out, when the three-way cock *j* is turned to shut off the air and allow the air behind the pistons to escape.

The cutter is centered in the chuck by

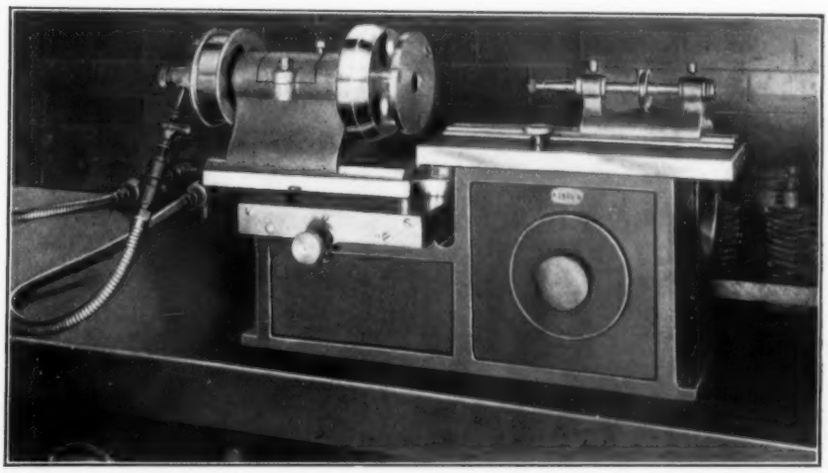


FIG. 5. MACHINE FOR GRINDING HOLE IN CUTTER.

gage passed through the hole shows the cutter to be of correct thickness.

In the bench grinder, Fig. 5, where the cutter bore is ground to size, the work is held by compressed air acting upon pistons which draw back a clamping plate attached to the face of the chuck. The general arrangement of the machine and the air connection will be clear from the half-tone. The internal construction of the head is shown in the sectional view, Fig. 6, *a* being the spindle, *b* a draw-in chuck body with a head for the cutter and retainer plate, and *c* a cutter in position to

means of a plug having a pilot ground to fit the bushing in the chuck face and a body which will just pass through the cutter bore before the latter is ground out.

The cutter teeth are ground to gage on the sides, and also on the ends except in the case of V-thread cutters, in the automatic machine shown in Fig. 7. Here the cutter is mounted on an arbor provided at its outer end with indexing mechanism, and at either side is a grinding head which may be set by graduations on the base to any angle necessary for grinding the sides of the teeth, while at the front is a third

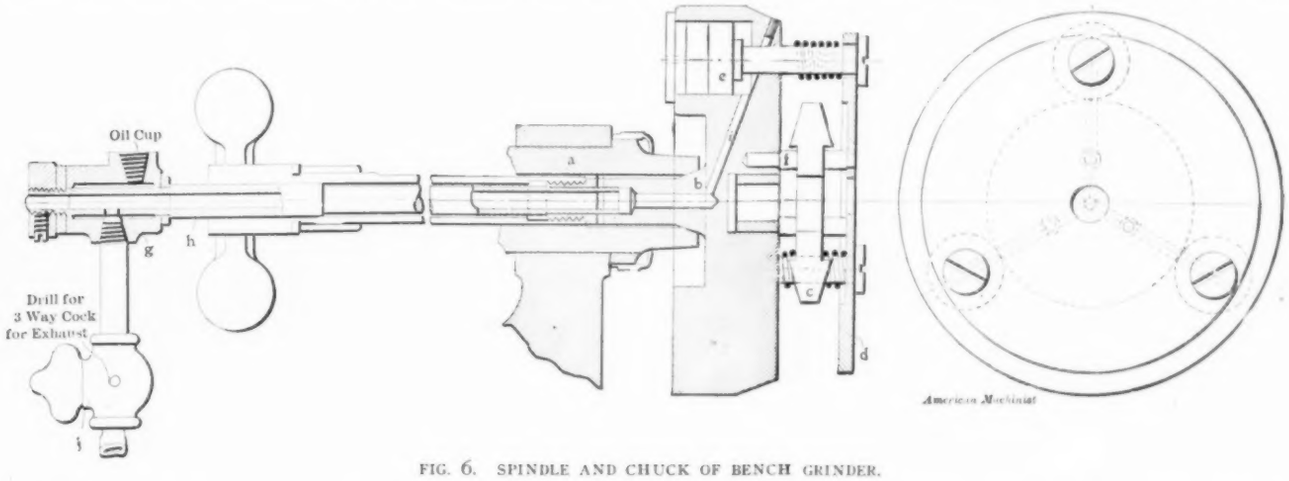


FIG. 6. SPINDLE AND CHUCK OF BENCH GRINDER.

finished simultaneously, after which the cutter is put in the bench grinder, Fig. 5, where the bore is ground to size. In the former machine the cutter, as it comes from the hardening department, is slipped

be ground. The plate *d* which secures the work is drawn back by three pistons *e*, and forced outward again, when air pressure is removed, by springs on the piston rods. Three hardened and ground pins *f*

adjustable head carrying a wheel which is moved back and forth across the tops of the teeth. The three wheel spindles are automatically reciprocated by the vertical arms connected at the outer ends of the

sleeves, these arms being moved to and fro by links connecting them with cranked mechanism operated from the driving shaft. The grooved driving pulley on this shaft also controls the movement of the indexing pawl which turns the cutter ahead one tooth after each wheel has passed twice over the edge of the tooth being ground. The spindles set at an angle to the cutter axis have a reciprocating movement exceeding somewhat the length of the largest tooth ground on the machine; and the movements of the spindles alternate with each other so that there is no possibility of one wheel interfering with the other. F. A. S.

Handling Glue in Warm Weather.

The glue made at the present time is, as a rule, much superior to that of a quarter century ago; that is, there is more of a high grade to be had, and prices are lower than they were, quality for quality. The little difference in the price of the best and that of any lower grade that could be used at all is so slight that every man can afford to use the best. Next to the quality of the glue comes the preparation, and it is an easy matter to render the best glue valueless. Glue as now sold comes in broken pieces, generally very thin, and the best, when held to the light, is semi-transparent, although some fine glue is sold in squares that are ⅛ inch, more or less, in thickness. The other form is the ground glue. Soaking glue before melting requires care, as the best can be weakened by allowing it to soak until it begins to show decay. This condition is easily detected by the smell. The pure glues do not emit objectionable smell unless decomposition begins, and it is this decomposition that reduces the adhesive properties of the glue. For this reason soaking should not be continued any longer than is necessary to soften the glue without reducing it to a pulpy mass. The purity of the best grades is such that even if soaked in cold water, six to eight hours is sufficient; if tepid water is used, six hours is the maximum time necessary. All who have given the matter close attention know that there is a marked difference in the amount of water that will be absorbed by different makes of glue when soaking, and also the amount necessary to dilute it to a working consistency. It follows, therefore, that the best results can be obtained by using one brand, if tests prove it to be of high quality.

After the glue is soaked it should be melted as quickly as possible in the double glue kettle; none other is fit for use. The interior kettle should be of copper or the modern enameled ware; the iron kettle discolors the glue and the effect of the action of the iron upon the melted glue causes it to rot. This is the case particularly when the glue is reheated two or three times. In the copper or enameled kettles no change in color is noticeable until the glue begins to decompose. The glue kettle should have a good cover, one that will keep out dust and dirt, and it is a good plan to have a pocket as well in which to keep the brush when not in use; leaving brushes in the hot glue and allowing them to remain in until the glue gets cold, leads to the accumulation of dirt, besides doing injury to the brush and eventually loosening the hairs. If ground glue is used, soaking, as generally understood, is unnecessary; but it is well to wet the powder with tepid water and allow it to stand a half hour or so, before melting. In hot weather it is a good plan to put in a few drops of an essential oil to retard decomposition. This is particularly desirable when the melted glue is poured out in shallow pans to await future use, instead of its being allowed to stand and simmer over the fire for a day or more. This cooled glue is dissolved quickly by heat, and retains its consistency, whereas glue that is allowed to remain over the fire for several hours thickens through the evaporation of the water, and must be thinned before it can be used, and it happens too often that cold water is poured in, or that hot water out of the iron kettle is employed, both of which tend to injure the glue. We omitted to state, when referring to soaking, that pure water should be used; soft water is the best; next to that is condensed water; the most objectionable is hard well water. This suggestion as to the selection of water should not be treated lightly, as the water exerts a marked influence upon the glue, both as to tenacity and durability. Water from creeks is often used, but it is so charged with organic matter that decomposition is hastened. In shops where large quantities of glue are used, one man should be given charge of its preparation for use, and keeping it in the proper condition. If this is done, responsibility can be located, and the man can familiarize himself with the peculiarities of the glue, the time that it can be kept without injury, and such other conditions as may best fit it for use. —*The Hub.*

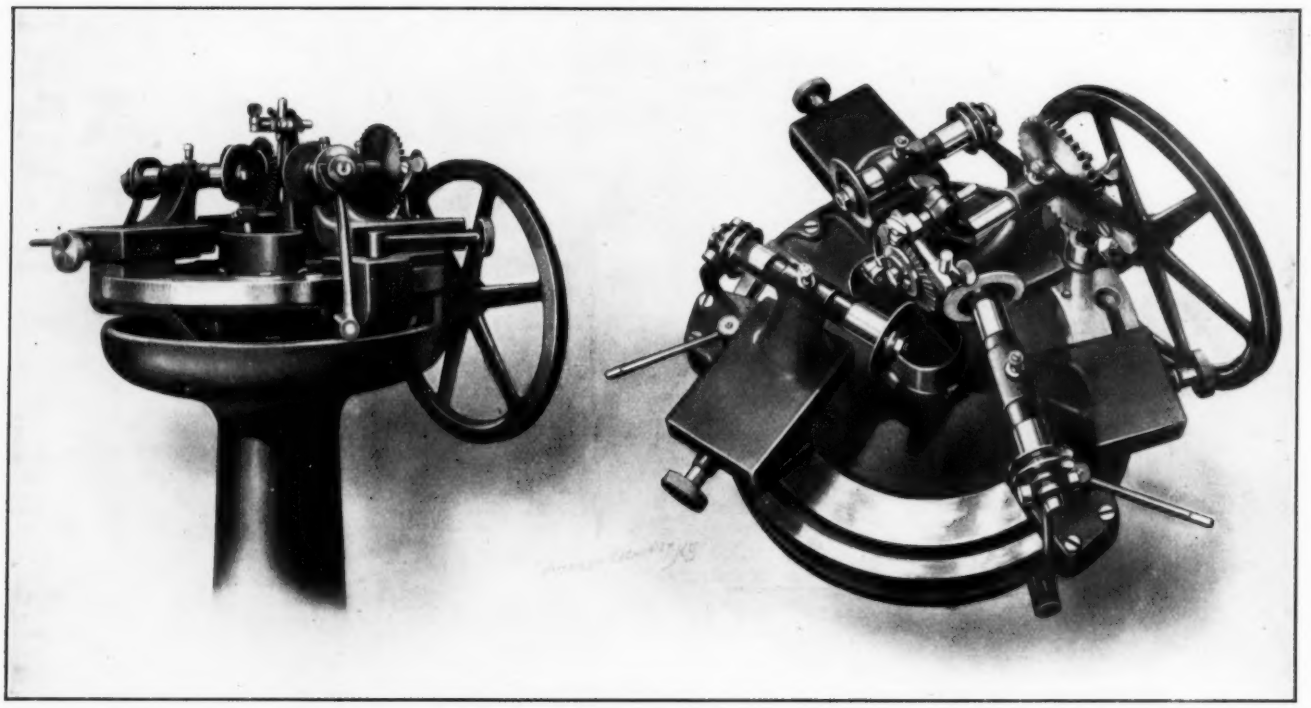


FIG. 7. AUTOMATIC GRINDER FOR CUTTER TEETH.

The St. Louis Exposition—VII.

EDITORIAL CORRESPONDENCE.

THE GREAT MECHANICAL EXHIBITS.

In the eyes of the public, to which nothing appeals like a steam engine in motion, the combined Westinghouse exhibit will probably hold first place among the mechanical exhibits at St. Louis, and while the judgment of engineers will vary in accordance with their own estimates of what constitutes greatness, many will agree with the general public. It is the main power service electric plant of the exhibition and consists of four units each of 2,000 kilowatts capacity.

At Chicago, in 1893, the great central station plant, which also was installed by the Westinghouse Electric & Manufacturing Company, was a complete exhibit of the most modern type of electrical machinery at that time, and the twelve 750-kilowatt generators at 2,200 volts were the largest alternating-current polyphase machines ever constructed and constituted the largest polyphase plant then in service. The 2,000-kilowatt three-phase alternating-current generators of the St. Louis Fair plant, which operate at a speed of 83½ revolutions per minute and deliver a 25-cycle current at 6,600 volts, altho of almost three times the individual capacity of those seen at Chicago, are of course not at this day remarkable on account of their size, and indeed entrance to the service plant exhibit is through a large 35-foot plaster ring molded in close representation and in exact duplicate size of the stationary armature of the 5,000-kilowatt alternating-current Westinghouse generators constructed for the elevated and subway train service in New York city.

Altho the service plant generating units are not of the largest type known to-day, the advance in the art in the meantime is such that there is little in common between the Chicago service plant of 1893 and the St. Louis service plant of to-day except the name of the manufacturer. The total space occupied by the service plant with exciter units, condensers, cooling towers and switchboard is 26,260 square feet.

Perhaps as noteworthy a feature of the plant as any is the condensers, of which there are two of the siphon type with a dry vacuum pump connected to the condenser heads. The water is used over and over through the medium of cooling towers, and on the day of my inspection the vacuum gage stood at 27½ inches. The engineer assures me that 29 inches is frequently exceeded.

The Westinghouse exhibits and preparations for the reception and entertainment of visitors are on a noteworthy scale. In addition to the exhibit proper which is enclosed within ornamental staff walls and columned entrances of classic design, is an auditorium which seats 350 persons, in which are displayed at regular hours through the day the biograph and mutoscope pictures of scenes in and about the various Westinghouse works in the Pittsburg district, and which will be used throughout the fair as a meeting place for scientific societies and technical congresses.

Exceeding in size any one of the Westinghouse units is the Allis-Chalmers-Bullock unit of 5,000 horse-power, which is centrally located in the Palace of Machinery and forms a striking feature. It is devoted to decorative lighting of the grounds and supplies current for over 120,000 incandescent lamps. At this plant is located the switchboard from which the gradual turning on of the lights at night is done. The engine is of the type designed for the Manhattan power station in New York, but the low-pressure cylinder is of six inches larger diameter than those at the Manhattan station. The small exciter unit alongside is particularly pleasing in its operation and has an attachment for traversing the brushes lengthwise over the commutator with an obviously favorable influence on the wear.

The Niles-Bement-Pond Company's exhibit is far and away the greatest display of machine tools ever made by a single corporation. Of its striking features are the 10x10x30-foot variable-speed pneumatic clutch planer, the 20-foot boring mill with additional independently driven boring bar, the horizontal spindle boring, drilling and milling machine, and several smaller tools with novel features. The entire exhibit weighs 868 tons and, as has been explained in these columns, it was erected without crane facilities—an accomplishment which is beyond the understanding of the average man.

From a strictly engineering standpoint the locomotive testing plant of the Pennsylvania Railroad must be given first place. The difficulties of a varying water pressure in the Alden brakes, which at first seemed to present formidable difficulties to the doing of satisfactory work, have been so far overcome that satisfactory tests have been completed on one locomotive which at this writing is about to give place to another. The apparatus has developed certain unexpected limitations, but within its range it works well. One of the surprising results already obtained is the disclosure of the effect of the heavy counterbalance on freight locomotives when run at high speed, the centrifugal force of which is such as to actually reverse the direction of stress upon the registering apparatus. Surprising as this may seem, it cannot be questioned. Data from tests in both tabular and graphic form are beginning to accumulate in large, and will of course accumulate in much larger, volume. The autographic records of the traction dynamometer are most interesting things. The pen vibrates of course with the varying impulses due to the crank and counterbalance weight angles, forming a cycle of hills and valleys for each revolution which repeats itself with surprising regularity for hours at a time.

Across the aisle from the testing plant and awaiting its turn at the dynamometer is a strikingly handsome four-cylinder compound locomotive designed by Alfred de Glehn and built by the Société Alsacienne de Construction Méchanique, of Belfort, France. This engine, which is of the latest and highest type of French fast passenger locomotive, has been imported by the Pennsylvania Railroad to learn whether it possesses features that can be adopted with advantage in this country. After being tested it will go into regular service on the Pennsylvania lines.

An idea of the magnitude of the work in progress at this testing plant may be gathered from the fact that the manning of the plant involves the attendance of thirty-nine men.

Because, I suppose, I have a weakness for the work of the pioneers who blazed the way through the wilderness and taught us all, the Baltimore & Ohio exhibit of old locomotives and reproductions holds first place in my own estimation. If the official photographer ever gets through falling down on deliveries of photographs, I hope to present to the readers of the AMERICAN MACHINIST some illustrations of the development of the locomotive, which I can only hope will prove to be half as interesting to them as to myself.

A goodly proportion of the newer machine tools shown at St. Louis have already been illustrated and described in our columns, and in fact the weekly record of new tools, as presented by us, is necessarily more up to date than any exposition of tools can be. Nevertheless, there are tools here that we have not shown and that possess points of novelty. These we shall attempt to give an account of, but will not, of course, undertake to catalog the exhibits or to mention, simply because they are shown here, a long list of machines already familiar to our readers.

THE BETTS BORING AND TURNING MILL.

The Betts Machine Company shows a number of heavy tools, all of which possess at least some points of novelty, and some of them several such features.

Fig. 1 shows a 6-foot boring and turning mill that has a speed change mechanism which, tho it is essentially the gear-cone-and-movable-idler idea, is worked out in a new way, particularly with reference to the heavy driving which in this instance is done with it. The photograph in connection with the drawing, Fig. 2, will make it readily understandable. There is first a motor resting upon a self-contained base and from this a chain drive to a shaft *A*, to which are keyed the five gear wheels shown. The parallel shaft *B* carries the complementary gears, and any one of these pairs is connected at will by shifting the lever *C* which carries the idler *D*. The lever *C* is pivoted upon rod *E*, and may also slide upon this rod to bring the idler into the plane of the two gears to be connected. The rod *E* is the upper member of a rectangular frame which in turn is pivoted at *F*. At the left of the

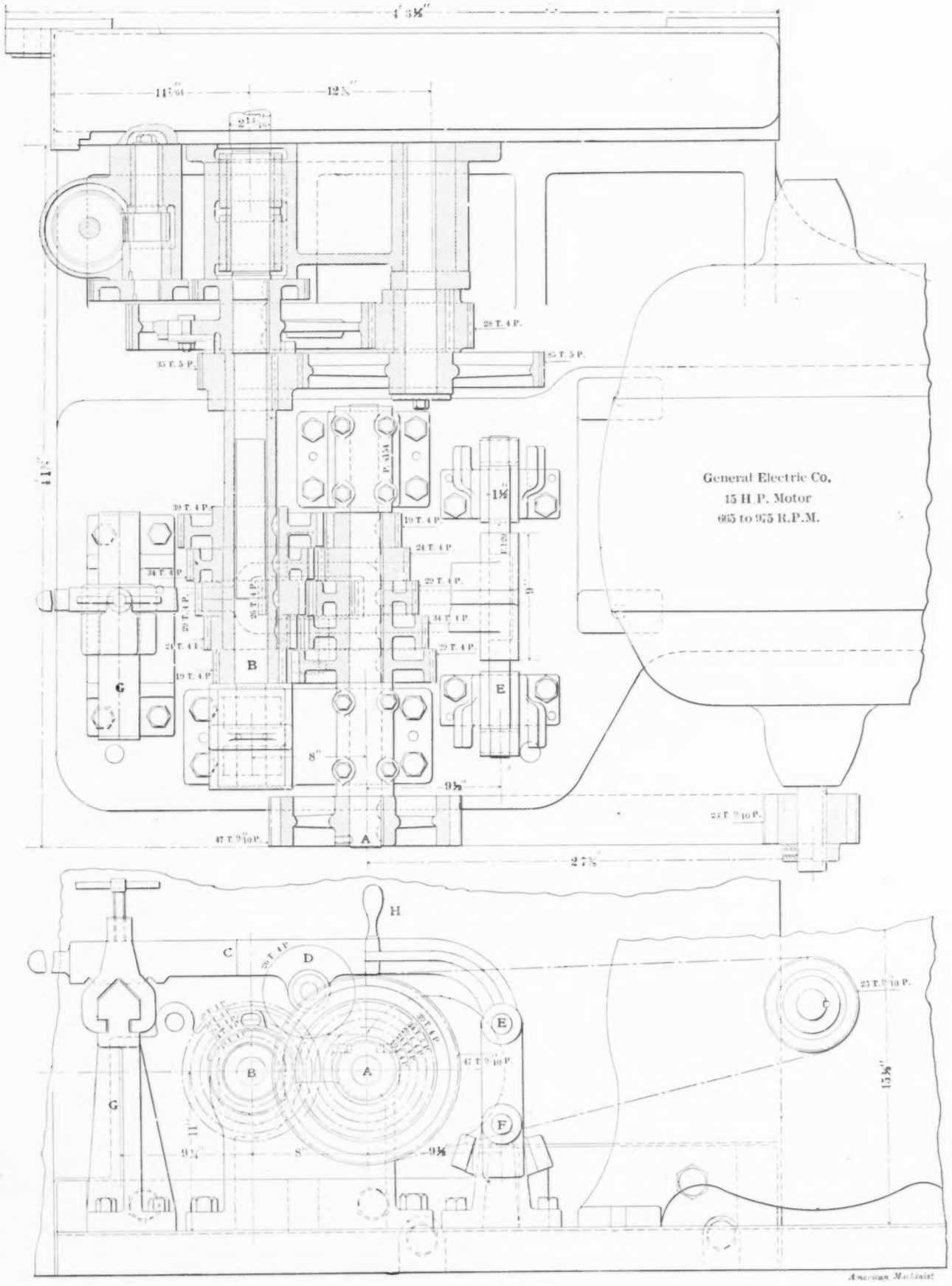


FIG. 2. DRIVING ARRANGEMENT OF BETTS BORING MILL.

gears is the fixed standard *G*, the top of which is formed as shown, to engage with any one of a series of notches formed on the under side of the bar *C*, and each of these notches defines and fixes the proper position of the idler *D* for a given speed ratio. There is a locking device, as shown, which holds the lever *C* firmly in position, and in manipulating the lever, the left hand is placed upon the handle at the extremity of the bar for lifting it, while the right hand applied to the handle *H* enables it to be easily shifted upon the rod *E*, and when clamped in position the pinion is firmly held and the drive is very steady.

The motor, which is 15 horse-power, is field-controlled 1½ to 1, while the steps of the cone gear drive are about 1⅓ to 1, so that the motor variation slightly overlaps the continuous geometric curve representing the speed variations.

The photograph shows also a new method of balancing the cutter-bars, by means of which each bar is separately balanced by its own counterweight, so that either of the saddles or bars may be moved without in any way affecting the other saddle or bar, and, as will be noted, no chain passes across from one saddle to the other in front of the cross-rail face, this space being entirely clear for the passage of rope slings or chains used in placing work upon or removing it from the table.

The arrangement of this chain will be readily understood by following from its point of attachment at the left of the bar nearest the observer, down under a sheave on the bar up to the sheave at the right of the bar on the saddle over the three idlers on the bracket at the end of the cross-rail (one function of these being to take care of the chain at different hights of the cross-rail), thence around the sheave, which is just at the rear edge of the upright (this last named sheave being held in a yoke, to which yoke is attached the weight chain), and back around the fourth idler on the cross-rail bracket along the cross-rail to the sheave seen on top of the rail between the saddles, and thence to a point of attachment to the saddle, not visible in the case of the chain we have been following, but shown for the other saddle. The points of attachment to the two saddles and the two sheaves on the rail are in different vertical planes, so that either bar may pass slightly beyond the center of the table without interference. The table is worm-driven, and no part of the mill extends below the floor line.

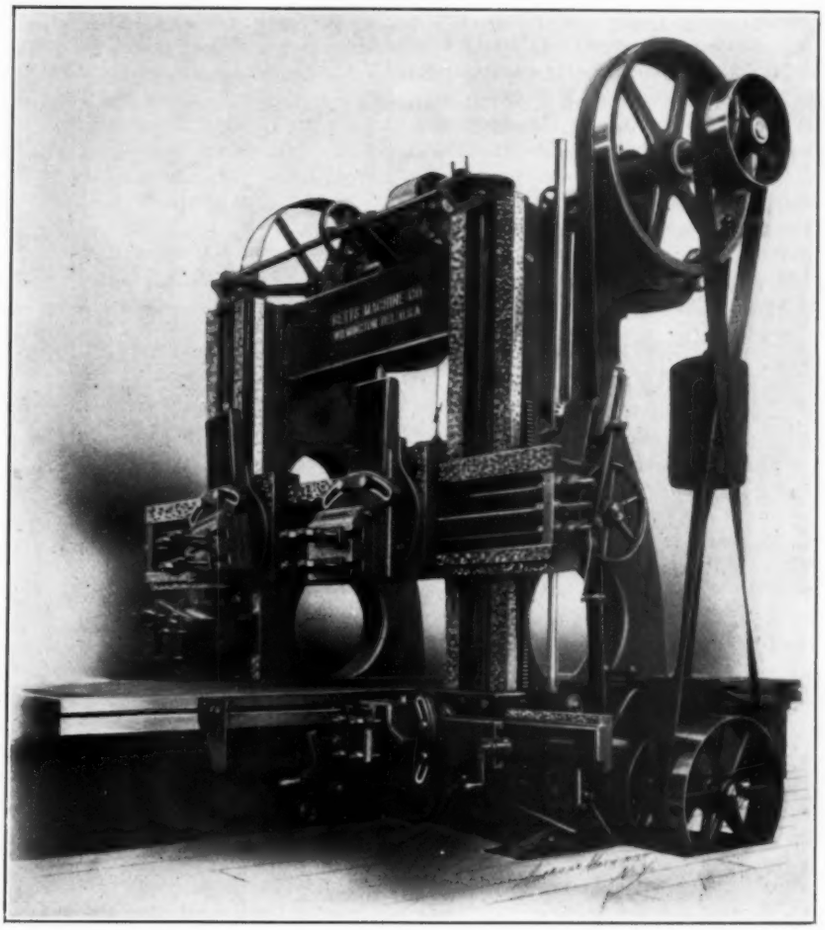


FIG. 3. BETTS PLANER. 72 X 72 INCHES.

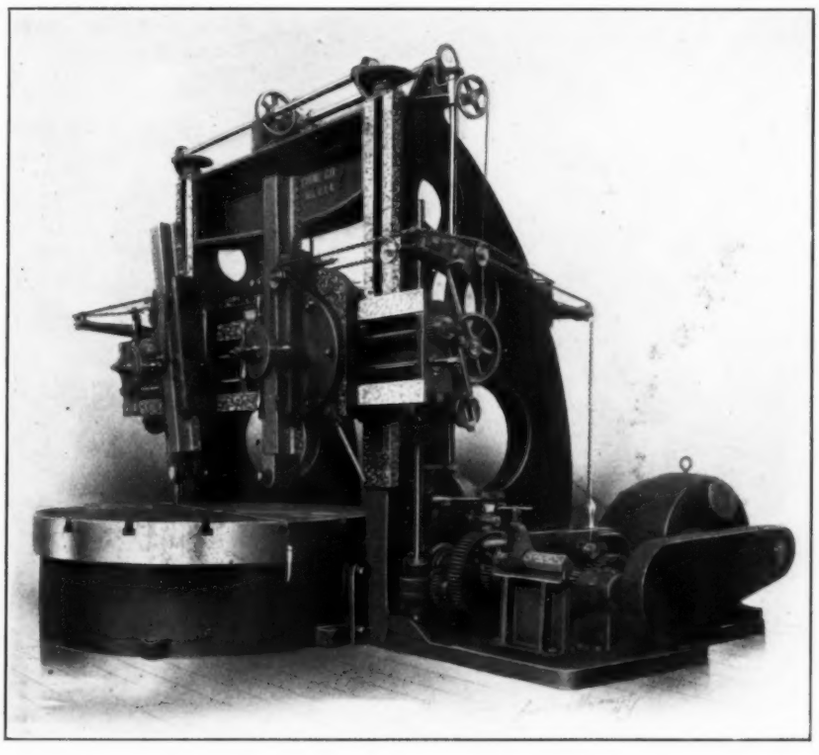


FIG. 1. BETTS BORING AND TURNING MILL. 72 INCHES.

THE BETTS PLANER.

The planer exhibited by this company is shown by Fig. 3. Its distinctive feature is that the side heads fitted to the uprights have long slides, by means of which the shorter slides (which may be swiveled to any angle) may be carried in toward the middle of the platen, and thus enable work to be operated upon that would otherwise be inaccessible for them. This is a 72x72-inch planer, and the uprights are 20 inches across the face. The cross-rail is clamped to them both inside and out—*i. e.*, at four places. The machine is driven by a 25 horse-power, con-

stant-speed, compound-wound motor, and all the driving gears are of steel, so mounted that all torsional stresses are carried through sleeves of large diameter instead of through shafts, with the object of reducing torsional vibration. These sleeves are bushed with bronze.

VARIABLE SPEED GEAR FOR SLOTTER.

The slotter shown by this company is illustrated by Fig. 4. It is driven by a 5 horse-power variable-speed motor having a range of 1½ to 1 by field control. The motor is bolted to the back side of the frame, and further variations of speed required are obtained by means of the four sets of gears shown, any pair of which is put into action by a sliding locking device, which is made to pass from one gear to another by means of collars which are interposed between the hubs of the wheels, and which close the locking dogs together, allowing them to separate again after they have passed through, so as to engage the next gear. This change is made by moving the lever seen at the side of the machine.

HORIZONTAL BORING MACHINE.

A horizontal boring machine of the Bement type also forms a part of the Betts exhibit, and is illustrated by Fig. 5. It is driven by a 7½ horse-power variable speed Northern Electric motor having a range of speeds of 3 to 1 by field control. The machine is triple geared—*i. e.*, the sleeve which takes the place of the cone pulley and is driven from the motor in the manner plainly indicated, drives the

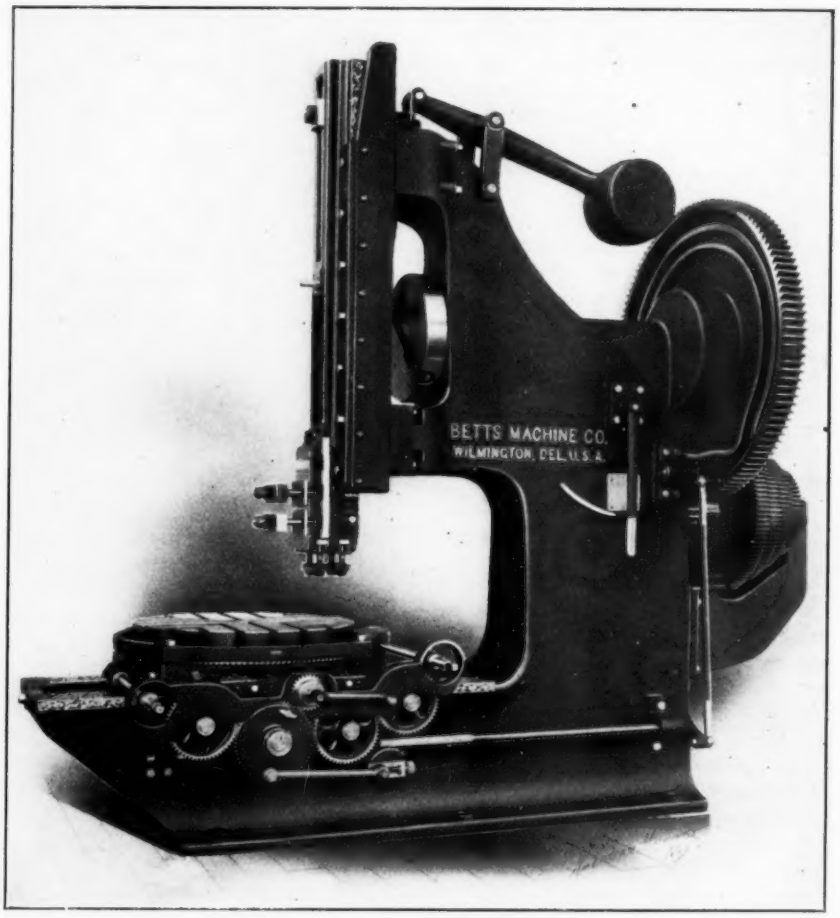


FIG. 4. BETTS SLOTTER.

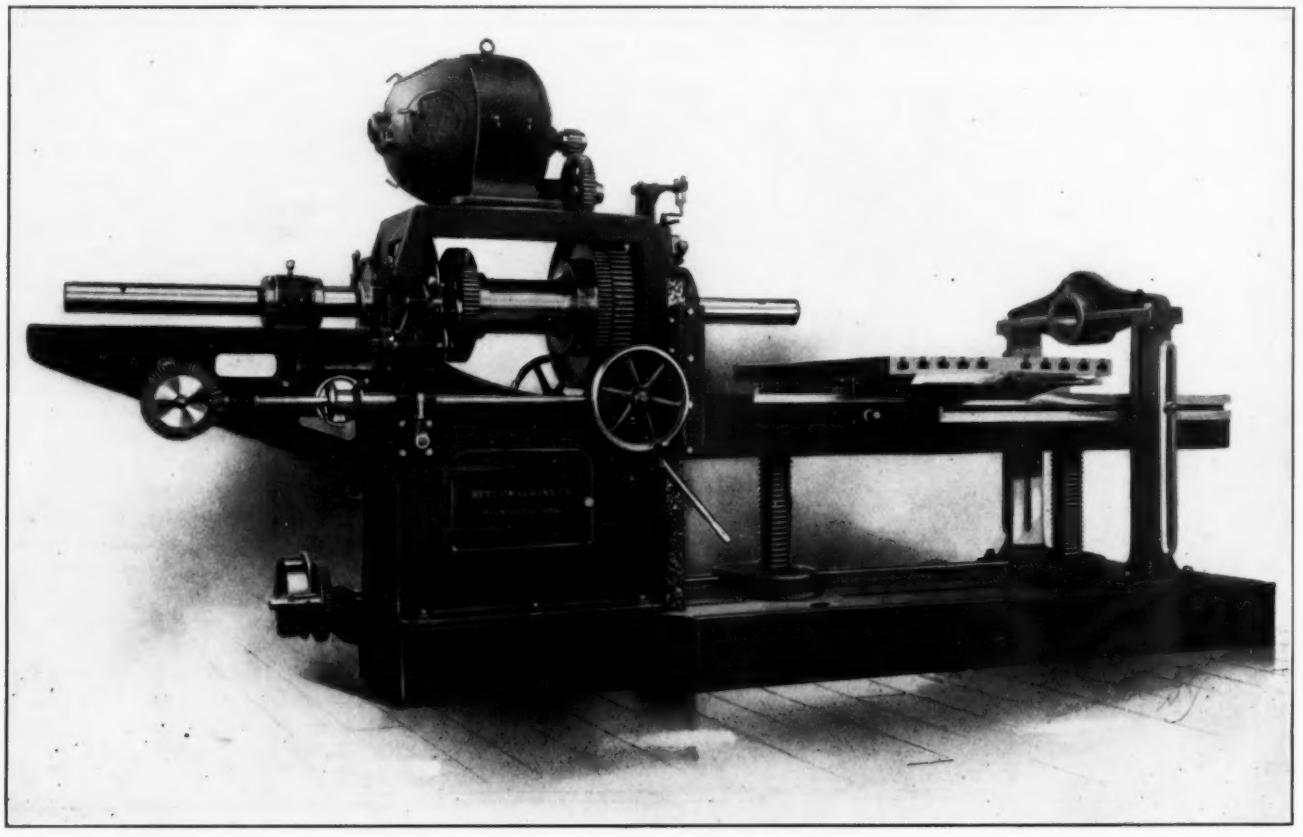


FIG. 5. BETTS HORIZONTAL BORING MACHINE.

spindle direct, or at two different gear ratios.

This machine is arranged so that the platen, screws, etc., may readily be taken off, and when this is done work may be fastened direct to the bed-plate by means of T-slots provided for the purpose, or may be held in any sort of special fixture or mounted upon parallels.

A MAMMOTH WOOD PULLEY.

In keeping with the general idea of making the St. Louis Exposition the biggest thing of its kind ever gotten up, the Reeves Pulley Company, of Columbus, Ind., has in Machinery Hall one of its wood pulleys, that is so large that it forms one of the most prominent features of the place. Some idea of its size is obtainable from the engraving, and the statistics pertaining to it are: 240 inches diameter, 50 inches face, mounted on a 12-inch shaft. It is split—*i. e.*, made in halves—and is built up out of Southern Indiana oak boards, glued and nailed together, the arms being composed of such boards separated from each other by rim segments, between which they pass and form a portion of the rim. The pulley weighs something over 12,000 pounds, and four men were employed thirty days in building it. It is, we understand, not built solely for exhibition, but for use eventually, the Reeves Company having previously built pulleys approaching this one in size. The exhibit includes also several of the variable speed transmission devices made by this company, and which have been made familiar to our readers.

F. A. H. AND F. J. M.

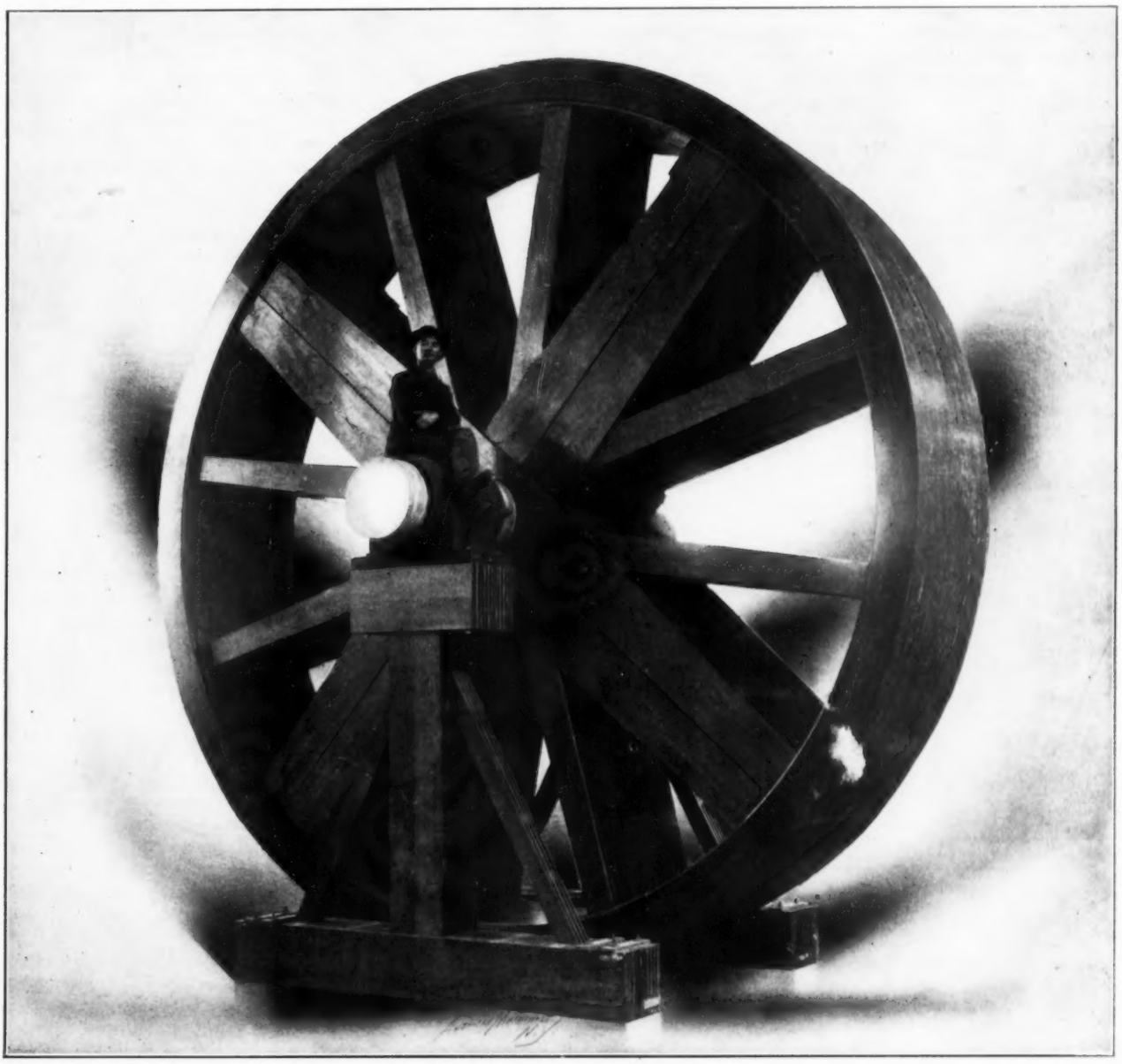


FIG. 6. 240-INCH WOOD PULLEY SHOWN AT ST. LOUIS.

English Out in the Shop.

"Say, what shall I do with this casting? The core in it is out. I knew that it was out before I put it into the chuck, but I thought that I could throw it out enough to make it true out. Now I find it is out too much to true out, although I threw it out all I dared to. What shall I do with it now?"

The superintendent seemed put out to see how far it was out, as the lack of it would throw him out in his calculations; but his only answer was, "Throw it out."

The foundry boss was somewhat out of temper when he found out about it. "A molder that was paying attention to business should not turn out a casting like that. He should have found out that it was wrong when he shook it out, and thrown it out then, and not have allowed it to go out," he exclaimed.

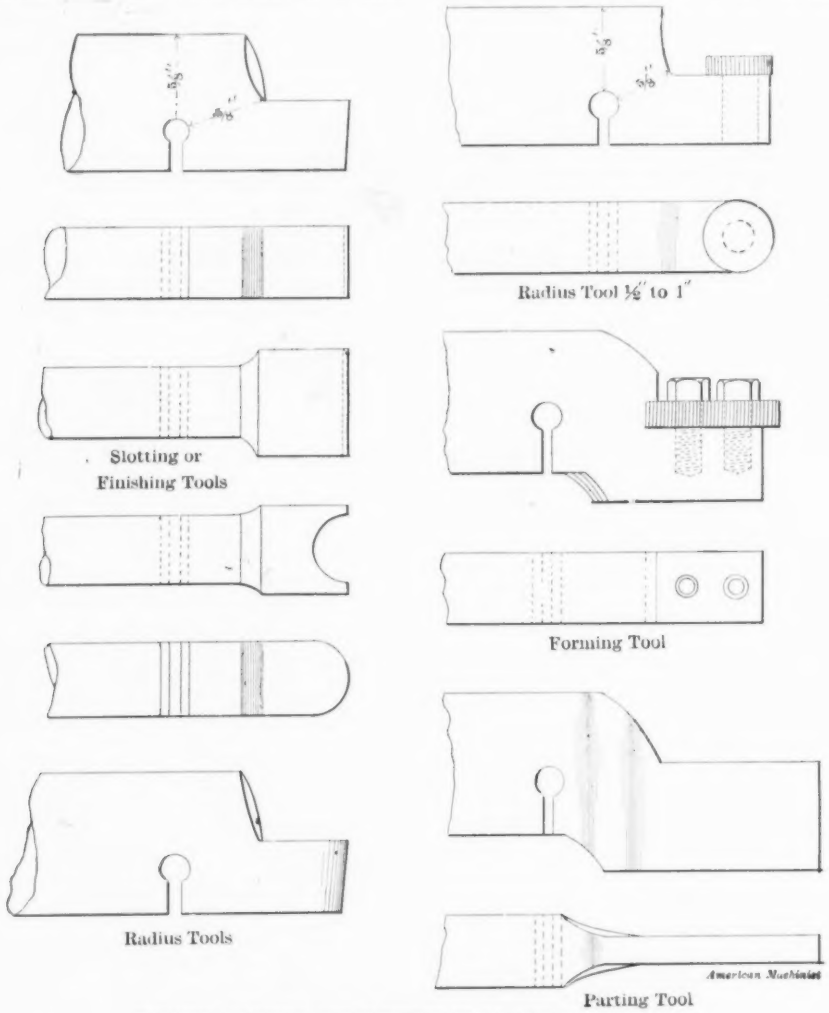
"Tell him to watch out a little better what he is doing, as too much of that kind of work would make us let him out," was the reply, and the occurrence passed out of the active issues before the shop.

Letters From Practical Men.

Forming, Parting and Slotting Tools and Tool Holders.

Editor American Machinist:

There is no doubt many of us have used the old-style solid forming and parting tool with very poor success. Some time ago I had a very large and difficult forming die to make in a factory where we did not have the best blacksmithing facilities and where everyone did his own forging. I decided to make a tool like the one shown in preference to the old-style so-called goose-neck tool, which is a more difficult and expensive one to make. I found it to work well, and to be simple to make. A. E. A.



FORMING, PARTING AND SLOTTING TOOLS AND TOOL-HOLDERS.

Grinding Parallels.

Editor American Machinist:

In connection with the letter of "Toolmaker," at page 598, I would say that when I have thin or small pieces to grind or to do machining on I solder them down by dropping a little solder at the sides or ends, or, if that is impossible, I use shellac, let it dry a little and stick the piece to be machined on to the table or the face-plate, as the case may be. A surface of wood is of course preferable for this. When grinding reamers or other tools where the teeth do not come opposite for calipering, I solder a piece on opposite the tooth and grind that also and then caliper from it to the tooth opposite.

C. W.

Expanding Gray Iron by Heating.

Editor American Machinist:

At page 447 I saw an article by Alex. E. Outerbridge, Jr., telling how to enlarge gray-iron castings with heat. Several days after reading it I chanced to have a small marine gas engine piston, 3½ inches diameter by 4½ inches long, to fit up. It had been turned a little slack for the cylinder, and no amount of care with the rings would give and hold the right compression. I got an old piece of 5-inch pipe and some dry sand from the molding shop, and, seeing that the piston was well packed into the pipe, I took it to the blacksmith and told him to put it in the forge about 5 o'clock and to let it cool off with the fire after 6. The next morning I thought of giving it another heat, but it chanced that the forges were all busy, so I took it out and tried to start it in the cylinder. It would have taken a sledge to drive it in an inch. There was very little, if any, difference between the solid head end and the open lower one. There was quite a look of astonishment when I took it down to the lathe hand who had "fitted" it, and told him to take another light touch off, as she didn't quite enter. As most of our work is repairing old machinery of every description, I feel safe in saying that in the future we will be less inclined to ransack the pattern shop every time we want a good fit of the piston in an old engine.

W. L. McLaren.

Machining Bronze Half Bearings.

Editor American Machinist:

The articles appearing recently in your columns discussing the machining of bronze half bearings make me think that a very much faster way is apparently not widely known.

The most perplexing problem is to make sure that the shaft will rest in one half-box exactly to its center at both ends.

Where any quantity of pieces are to be machined, the cheapest and most satisfactory way is to mill the entire inside of the box with the aid of a suitable jig and a formed cutter. The cutter should be made interlocking at the center of the half round.

By making the radius of the convex cutter about .004 or .005 inch less than the shaft size, line reaming is provided for, and every half-box is a duplicate of every other.

After milling, if they are clamped on an arbor and the ends finished, they may be clamped endwise and the outside turned, but the milling method for the inside, and contacts, is far cheaper and more satisfactory than any method of planing and boring or milling and boring.

In this regard I wish to call attention to the difference in price which various makers quote on work which they have been asked to estimate upon.

I had occasion to get some of these cutters made recently, and all of the prominent makers were supplied with a blueprint and asked to quote.

The concern which got the order is known for its good work in standard tools, but its quotation was 70 per cent. less than the highest offer and 30 per cent. less than the next.

Of course, they advertise in the American Machinist, but the question I am asking myself is, did the other fellows want too much profit or did they just guess at the cost without making an estimate? The same thing holds good in quotations on drop forgings, which sometimes vary over 200 per cent. in estimates from different concerns.

I have come to the conclusion that when a small job is considered, most of them do not give it the honor of a careful estimate but simply make a guess.

That may be justified by saying that a careful estimate is not warranted on a very small order, but it is well to bear in mind that the fellow with a twenty-dollar order just now may be in a position to

give a two-thousand-dollar one later, and he is pretty apt to remember where he got the most advantageous service before.

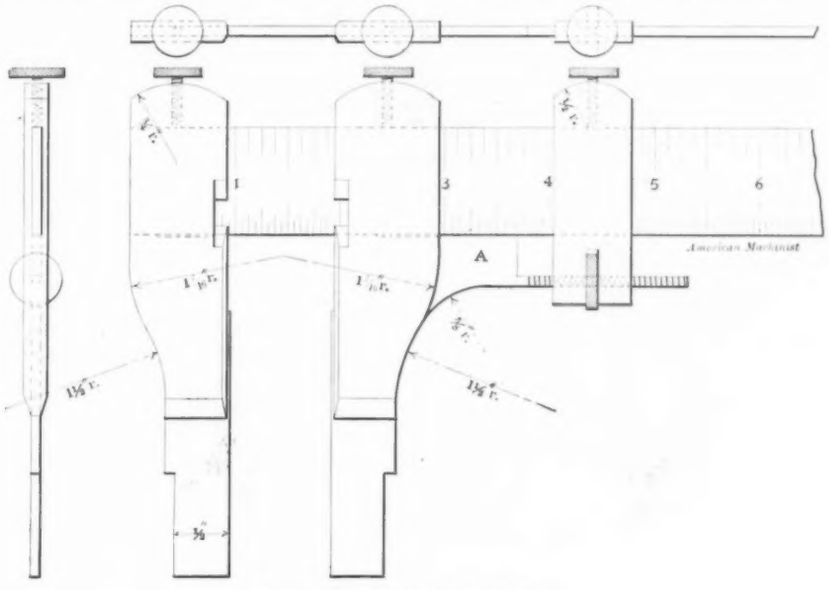
Freeport, Ill. TOOLMAKER.

[Geo. B. Grant in one of his old catalogs of gears says "estimating is only guessing."—Ed.]

A Caliper Rule Attachment

Editor American Machinist:

At page 595 I noticed a scheme for using two combination square heads for a caliper; I had used this idea before, but found it limited to only a few measurements. The drawing enclosed shows the device I now use, and it is a very convenient tool for inside and outside measurements. If placed on an ordinary 12-inch scale made by a reputable concern (the accuracy obtained on these scales is truly wonderful, considering the price at which they are sold) one has with the other attachments a combination tool of great convenience and reliability. The range of this tool is an important factor, as readings from 0 to 7 inches on round work are easily made to within one-half thousandth of an inch.



A CALIPER RULE ATTACHMENT.

The centers of the jaws are made of polished sheet steel and the outside of the same material half as thick, brazed with silver solder. The jaws are then hardened on the ends and lapped. The line adjustment is used and a vernier might be placed at *A*.

CYRUS TAYLOR.

Oil Holes and T-Slots by a New Method.

Editor American Machinist:

The new milling machine had been delivered and I, the shop foreman, was instructed by Mr. Knowall to test it, and report.

Mr. Knowall was a successful office man who thought that he knew as much about the machine shop end of the business as all the men in it, put together. You may know something about running the shop, but when it comes to buying a new machine, anything that requires the mercantile instinct to prevent us being swindled, your opinion is absolutely of no value; these people agreed to sell us a perfect machine and I intend to have it so, or ship it back to them."

I went into the shop to my work. A few days after Mr. Knowall, in passing through the shop, stepped over to my desk: "Mr. Dixie, I have been looking at that new milling machine table, and find there's plenty of metal in it, so that you can mill two more T-slots if you want them; and, by the way, did you drill the two oil holes in the loose pulleys?"

I was rather surprised at the workmanlike way in which he spoke, but disguising my emotions I replied that the T-slots could go for the meantime and that I had drilled the two oil holes.

Some time after this, while looking over the letter book to find the letters referring to another matter, I came across a letter to the makers of the milling machine, which ran somewhat as follows:

"Our foreman informs us that while the milling machine is fairly satisfactory, you have forgotten the oil holes for the loose pulleys, and the machine would in his opinion be more efficient if there were three T-slots instead of one. Kindly rectify this oversight and ship us at your earliest convenience two oil holes suitable for 16x4-inch countershaft loose pulleys and two extra T-slots for No. 2 milling machine table. Yours truly,

"KNOWALL & CHUMP."

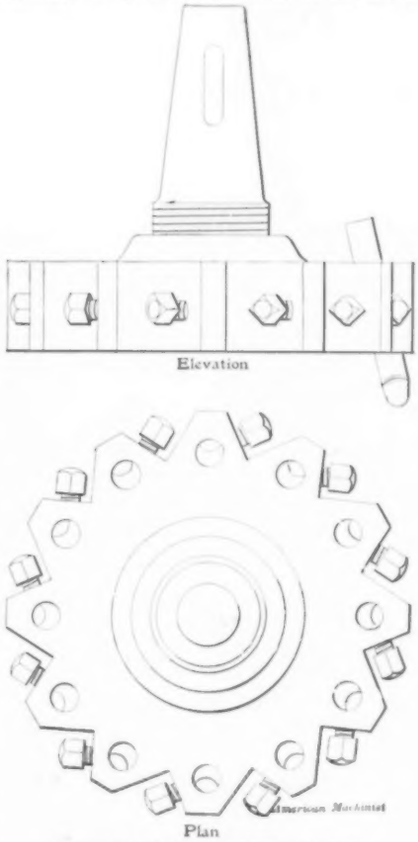
I suppose it was the reply to this letter that contained the information with which he overwhelmed me in the shop.

DIXIE.

Inserted Tooth Milling Cutters.

Editor American Machinist:

At page 1255, Vol. 26, a correspondent showed a milling cutter with inserted teeth. Having had experience with this as well as several other types of inserted tooth cutters for medium and heavy work on gray iron, I have never used one which gave results equal to the one here shown. For heavy work and with the new high-speed steels we have obtained excellent results with it. The cutters are made of round steel, ¾ inch diameter, as shown; they never require forging, and a minimum amount of grinding. The tapered shank is made of mild steel screwed into the cutting head. The cutters have an outward rake of 30 degrees, with 10 degrees forward rake. For cutters over 18 inches diameter two set-screws can be used for fastening each cutter, as the cutter head has more metal in being deeper. We use the cutters pitched 3 inches apart. The fine thread on bottom of shank is for forcing the cutter from the machine spindle by a nut. The cotter hole in shank is for driving the cutter, a flat on top not being strong enough, as tremendous power is required under heavy cuts. We use it



INSERTED TOOTH MILLING CUTTER.

on the very heaviest class of milling, both vertical and horizontal, and with high-speed steel cutters can take a roughing cut ⅝ inch deep with a peripheral speed of 65 feet per minute with a feed of 3 inches per minute. For finishing we increase to 80 feet per minute, with a feed of 6 inches per minute and a cut ⅛ inch deep.

J. DOWNING.

England.

Finishing Segments of Large Radii.

Editor American Machinist:

The problem was this: Given a certain number of cast bronze segments, to find

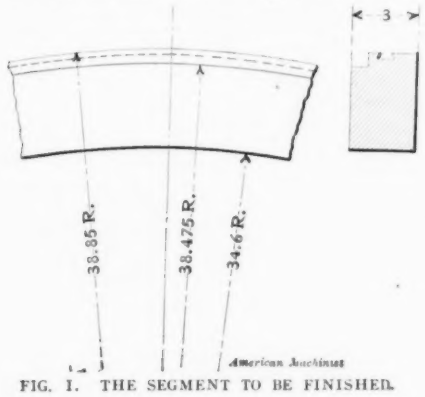


FIG. 1. THE SEGMENT TO BE FINISHED.

an inexpensive method of finishing them to the dimensions called for in the partial view, Fig. 1. Facing them off to the 3 inches width wasn't troublesome, of course, but the inside and outside arcs of

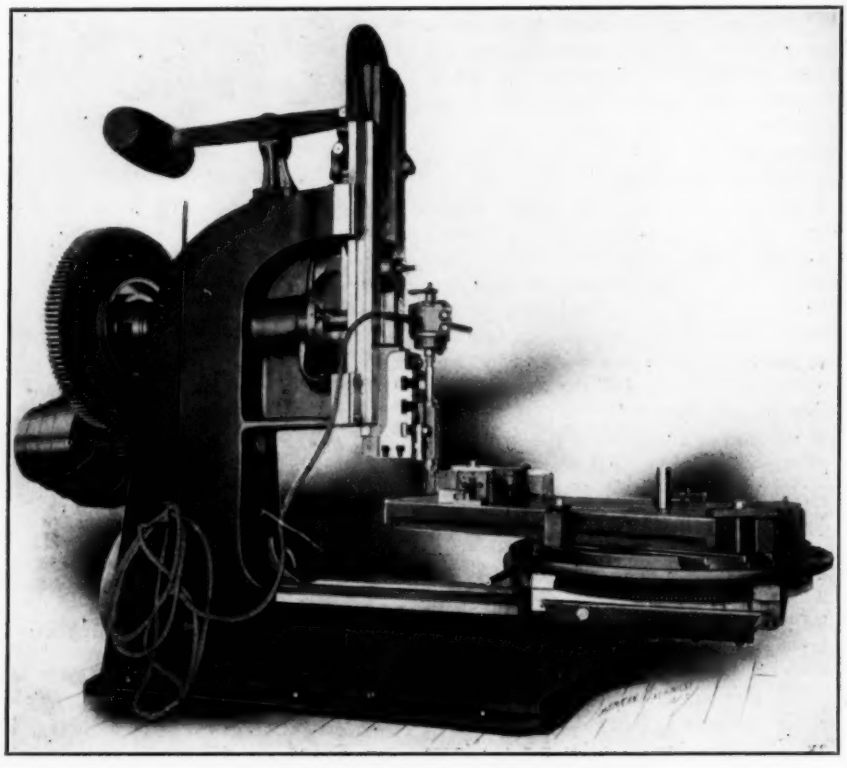


FIG. 2. FINISHING SEGMENTS OF LARGE RADII.

34.6 and 38.85 inches radius, respectively, the latter having the notch and dovetail grooves, weren't so easily handled. These segments, moreover, later were to have teeth cut in the inside edge and the completed piece to be subjected to rigid inspection before acceptance. Accuracy and smooth surfaces were therefore essential.

Figs. 2 and 3 illustrate the solution reached after several other plans had been discarded as impractical or too expensive. It will be seen that said solution involved combining an air drill with a large slotter. Fig. 2 shows the combination "rigged up"

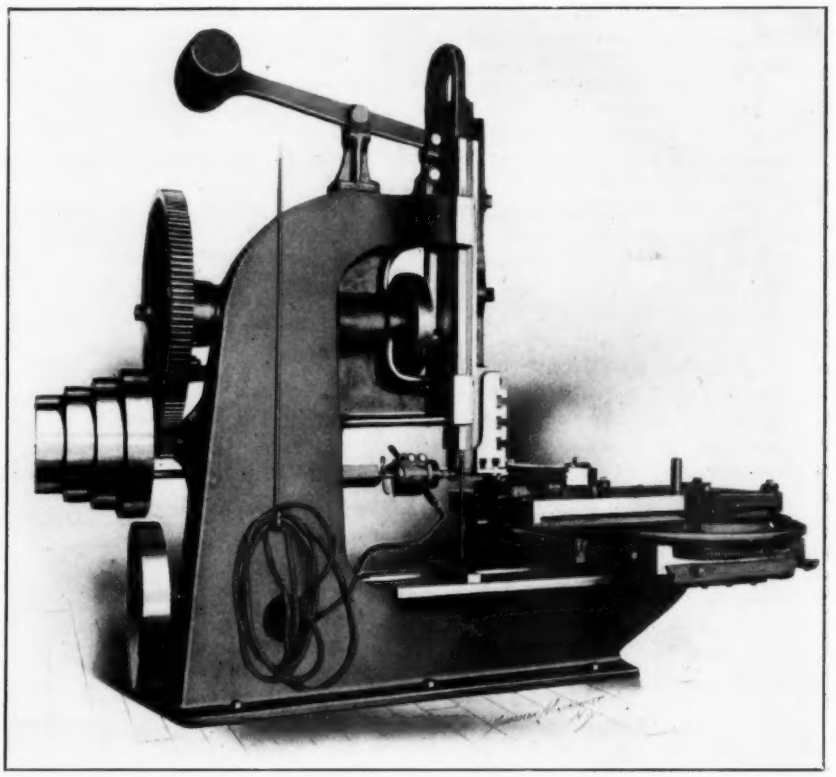


FIG. 3. FINISHING SEGMENTS OF LARGE RADII.

for the first operations. A spiral milling cutter 2 inches diameter was keyed to an arbor and held in place against a shoulder by a nut on the under side. This arbor ran up through the main bearing, which was of gray iron and which was bolted to the head of the slotter. The shank of the arbor was tapered to fit the air drill collet, the whole arrangement being prevented from moving vertically by two collars screwed to the arbor, one at each end of the iron bearing. Between the collars and the bearing were placed fiber washers, to insure smooth running. A small chain, not shown in the photograph, held the air drill down tightly on the arbor shank. The slotter head of course was immovable during operations at other times, but the hight of the cutter could be adjusted by turning the cone driving pulley. Making the head immovable means that the feed for the table couldn't be taken in the usual way by a ratchet movement from the large gear at the rear of the machine.

The arrangement, shown best in Fig. 3, was substituted. As indicated there, a pulley of large diameter was put on the main feed shaft in place of the regular ratchet wheel, the belt going to a "pull" countershaft fastened to the floor and the controlling handle being hung in convenient reach of the operator. The main belt was placed directly around the countershaft above to give the slow circular feed required.

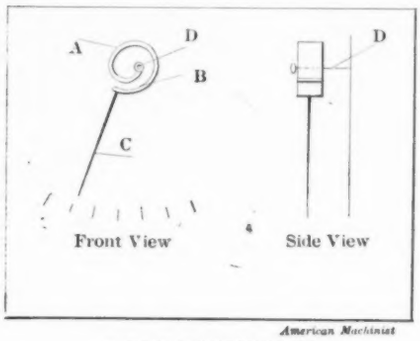
Fig. 3 also shows how the attachment was readjusted for milling the notch and the dovetail grooves. The same bearing was bolted to the under side of the slotter head, but a shorter drill collet was used to allow the insertion of the wooden block for clamping. A new arbor with a collet end for taking in the small end mill and dovetail cutter was also found necessary. The vertical rod seen under the slotter head was used as a hight gage for obtaining the proper position of the slots. Before starting the dovetail groove, it was found advantageous to remove some of the metal with the end mill and then use the dovetail cutter for undercutting the edges.

The finished segments were entirely satisfactory, the surfaces and grooves, being clean cut, free from chatter marks, and last, but not unimportant, the time limit not exceeded. The big slotter has now resumed its normal functions, but the rest of the combination is carefully stored away for future reference. R.

A Cheap Hygrometer

Editor American Machinist:

At page 729 of the AMERICAN MACHINIST appeared an article entitled "A Cheap



A CHEAP HYGROMETER.

Hydrometer," by Dixie. I beg to suggest that "hygrometer" might be less confusing and that "hygroscope" would be possibly more correct. I enclose a brief description of a contrivance which I have used to some advantage and trust that you may be able to find something of interest in it.

A is a strip of bristol board shellacked upon one side and coated with gelatine upon the other. While still moist, coil and leave to dry (in spiral form). *B* is the gelatine coating. *C* is a straw or whisk from a broom and is fastened by sealing wax to *A*. *D* is a pin or nail to which the coil is fastened by sealing wax, and thence to board or fence, etc. The coil should be about 1½ inches long by ¼ inch wide before being rolled up; the straw is about 1¼ inches long. This may be made upon a larger scale throughout with still better results.

Calibrate this instrument by any convenient method—such as by comparison with the reports upon humidity in the daily papers.

EDW. F. CHANDLER.

A Machinist's Experience in Mexico.

Editor American Machinist:

I once had the job of fitting up a framework for the main drive of a large cotton mill in the State of Vera Cruz, Mexico. The mill was an old one—some ninety years or so. Its motive power was furnished by five turbines in different parts of the building. The water supply for these was to be concentrated into two big turbines with an additional head of 60 feet.

My job was to erect a frame from the excavation which was to hold the turbines to the first floor of the mill, to carry the bearings, etc., for the main driving pulleys and other fixings. The materials to be used were old I-beams of steel and of widely varying degrees of straightness. These had to be cut to length with the blacksmith's cutter, for there was not even a hacksaw to be had in the small machine shop belonging to the factory. The ends had to be chipped and filed square by hand, and the engineer superintending knew if a job was right or not.

The drawings called for ¾-inch holes about every 30 inches for bolting together, and I think there were about 800 holes altogether.

The turbine for this floor was out of order, so I asked the boss to put down a small electrical motor to drive the drill press, as there was plenty of current available. He wouldn't do it, however; said: "Per mano, como no."

The drill press was a corker, and there was no mistake about the pressing part of it, even with the flat drill newly sharpened up—no such luxury as a twist drill.

Some genius, in building this drill, had drilled a hole through a gray-iron support column and fitted in a shaft with a pulley on one end and a gear on the other. The casting for the spindle was fastened likewise, and a big vat thing, used for husking coffee berries in, did duty, when reversed, for a table. Feed was imparted to the spindle by two chains, which were pulled by means of a ratchet wheel and pawl, which last was moved by a foot-lever.

I found an old grindstone, put a hand crank on both sides, fastened it to the floor, belted it up to the drill press, and had four men as power, in relays of two every fifteen minutes.

The gray-iron brackets for the corners measured 30x18 inches, were 10 inches broad, which last dimension was just an inch too much. They had all to be chipped and squared by hand and the drilling done mostly by ratchet.

I did try to square those brackets on a 4-foot by 20-inch planer that was a part of the shop equipment, but had to give it up. The table travel of this wondrous tool was effected by means of a chain such as is seen on automobiles. An old machinist told me that the links were all hand forged. The driving gear was at one end of the table and fastened to the floor. It consisted of a bevel gear engaging in two other gears alternately. These in turn drove the shaft, which had a sleeve over it to roll the chain on. It worked all right; but if anything more than a light cut was taken, the motive power went on strike, so I had to give it up, as it was altogether too slow; besides, the grindstone was required to drive the drill press, which was too busy to stand idle. To work under those conditions might make some sick and tired of their job before it was finished, but it didn't affect a

MECHANICO MEXICANO.

A Keyseating Tool.

Editor American Machinist:

The illustration shows a tool I made the other day. The problem was to keyseat some gun-metal articles and, as the hole was ⅜ inch diameter by 2 inches long, I thought it impracticable to chip or file them—the more so, as they had to slide on the shaft without much shake. This necessitated a smooth, straight keyway.

I took a piece of ⅜-inch shaft about 12 inches long, milled a keyway *A* in it about 3 inches long and inserted a tool shaped like Fig. 2. *B* is a ⅛-inch pin for a stop to take up thrust, *C* is a 1-16 pin holding tool in slot, *D* is the cutting edge.

I then held the articles in the universal

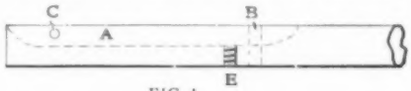


FIG. 1

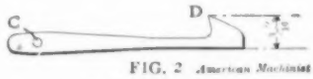


FIG. 2 American Machinist

A KEYSEATING TOOL.

chuck of the lathe, the tool mounted in the tool-post of the lathe. I then pushed through, tightening ⅛-inch screw *E* each cut. The tool and twelve keyways complete took 1½ hours.

JOHN P. WHEELER.

System in Fluting and Marking Taps.

Editor American Machinist:

Many toolmakers, altho good workmen, pay little or no attention to any system relative to the stamping of the diameter and threads per inch, etc., on taps, reamers and other tools. While this is apparently insignificant and has nothing to do with the cutting quality of any tool, it nevertheless shows neatness on the part of a workman that has a system of stamping taps a certain distance from the ends of their shanks in proportion to the diameter and length of the tap. Taps that are stamped on the shank *in line* with one side of the square, which is intended for the tap wrench, have a uniform and better appearance than when they are stamped in the usual haphazard way. A tap or reamer that has its size, symbol, etc., marked lengthwise on the shank should be made to read from left to right when the shank is held in the right hand. Taps

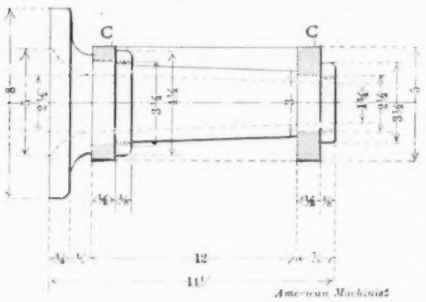
which are stamped the opposite to this have a left-hand appearance in this respect. In the fluting of taps very few toolmakers make any attempt to mill the tap so that the lands on all taps will be in the same relative position to the square on the end of the shank, but they look much better when made so, particularly when on the shelves in the toolroom, or laid alongside of each other for comparison.

R. M.

Testing a Lathe.

Editor American Machinist:

Having passed through some experience in lathe building and testing, the article at page 720 entitled "Lathe Testing" was



A RENEWABLE TEST PIECE.

particularly interesting. I consider the micrometer surface gage not so good as the micrometer itself, and, since Mr. Perrigo shows the micrometer in Fig. 8, it would certainly be better to use it in Fig. 7. An ordinary micrometer clamped against the side of a tool in the tool-post will do everything he has shown and, I think, do it better. A good test indicator, of which there are several makes, is so much better than a micrometer, because it is self-registering, where with the micrometer it is always necessary to set it up to take readings. With a good test indicator he could get the job finished in less than half the time.

I consider it poor practise to test the inaccuracy of a screw by comparing it with itself, but if an accurate screw is at hand it is comparatively easy to test the inaccurate one by revolving them both at the same speed, carrying the indicator by the accurate screw, leaving the contact piece to bear against the inaccurate one. I know of few shops where the lead screws are tested. The usual method is to get the machine accurate which produces them and keep it so by test. It is best to get the method which will make a screw right or good enough and let it go at that.

A test piece shown in Fig. 1 is used by one builder and is used for various sizes of lathes. It is good because of its simplicity and because the parts where the cuts are taken can be replaced when used up. Collars *C* are clamped by the threaded collars and are easily replaced. This rig will last a lifetime, where with Mr. Perrigo's idea it is necessary to have seven test pieces and replace them as they are worn out.

ART ISAN.

A Milling Jig.

Editor American Machinist:

The illustrations show a milling machine jig for straddle milling a small cam lever. The principle of this jig can be used in milling various pieces of work. There are five clamping bolts and each bolt clamps four pieces, so that the jig holds twenty pieces. They are held in such manner that the cutters are always at work.

Fig. 2 is a frame that is set over the pieces while they are in the jig before they are clamped. This frame holds the pieces in line and prevents them from twisting. This frame is necessary on this piece of work, for there is not very much stock to come off. The clamping surface is also narrow. Plenty of clearance (not shown) was given the end of lever, and room for the chips and oil to flow out was provided.

The top parts are made of soft steel case-hardened. The center or main block is screwed to the lower gray-iron plate. It was set over near the inside in order to use as short an arbor as possible. A crank wrench with a sleeve that slips over the large part of bolt was used to aid in getting the wrench on quickly. A pin in each clamp and a hole in the block prevent the clamp turning when the bolts are turned.

H. T. G.

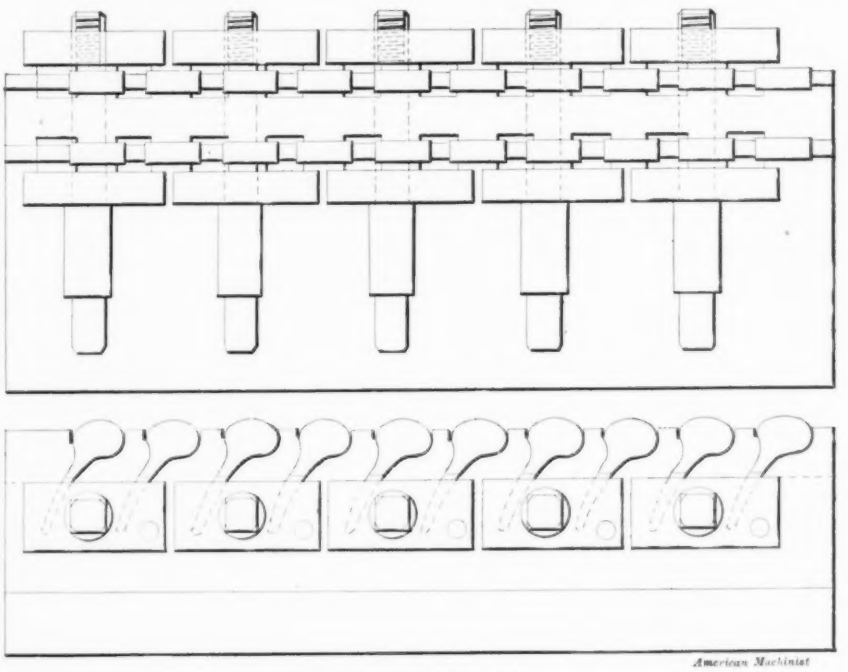


FIG. 1. A MILLING JIG.

FIG. 2. ADJUSTING FRAME.

Some Machine Tool Salesmen.

Editor American Machinist:

As the 'phone rings up I take off the receiver and shout "Hello!" to the fellow who is worrying me from the other end. "There is a man waiting here from Blank's, the machine-tool concern, and he wants to figure on the radial drill you wrote about yesterday." I remember I wrote to three concerns who make drills, so I told the boy to bring him right over to my office in the machine shop, and turned up my specification ready to talk. "Good morning. You are, I presume, the superintendent here. I am right glad to meet you. My name is Blank—John F. Blank. I am vice-president of our concern. We have been in the habit of doing our business through our traveling man, but as he is down South for a spell, and I was anxious to meet you, I came along myself. Besides, two practical men can do their business better, can't they? I want to sell you that drill you inquired on pretty bad. In fact, I mean taking your order away with me. Now, this is the specification you sent to us and you will find it is nearly like the machine of that class illustrated in our catalog. You haven't our catalog? Well, I am sorry, but I will send you a copy, and I quite forgot to bring along an illustration, but I will be glad to tell you anything you wish to know about it." "What radius will it operate?" I asked. "Well, now, I think it is 5 feet or 5 feet 9 inches, I am not quite sure; but the Westinghouse people have three of them and they are very satisfied." "What feeds do you give, and what is the diameter of the spindle? Is there a reverse motion for tapping? What is the range of speeds, and is it built suitable for high-speed drills?" I am afraid I asked him too much at once, for he wasn't quite sure as to the feeds and speeds, he said, and he'd have to look it up. It was foolish of him to forget the illustration, but he'd send that along, and the price and delivery, and

he hoped that I'd not pass him with the order, for he was sure it was just the thing I wanted. Just then there was another ring on the 'phone and the boy informed me that the tool salesman from the X concern had called on the same matter, and presently he was ushered in. He had all his papers, all right and without any delay placed before me the illustration, specification and price. "There is our tender, sir, and our delivery is thirty days. We have seven of these drills going through, and you may have the first one finished." I carefully studied his specification, and in the meantime he talked along as follows:

"You see, our people say this is the top notch drill on the market. I was present last week at a high-speed test against the Blank Company's new drill (I wasn't aware they had one) and we wopped them hands down. A big Milwaukee concern ordered four, so we put through seven." I grew interested. "What material were you testing on? What make of high-speed drill were you using, and how long did it last?" "Well, I don't know, but it went through the test all right and the chips were quite blue and the drill was as good as new at the finish." "Did you use any lubrication?" "Oh, yes, we oiled her up well before starting." This was not what I meant, but it was useless going further, so I promised to look into his drill and settle the matter by mail just as soon as I got all my tenders in. Now, both these men were just wasting my time and their own. I meet many such—real nice fellows, but men who cannot talk on the point of what they are selling. That is why I confine my inquiries to people who can satisfy my mind when they call.

JAYMAC.

An Unheard-of Rise in Transportation Charges

Editor American Machinist:

My old friend, Mr. Reed, who is very deaf, relates the following story which took place while he was chief engineer of a Southern cottonseed oil plant.

He once had occasion to send one of his darkies from the mill to a plantation some distance away. The tariff had been 20 cents, but was raised to 25 unknown to Mr. Reed, so when he dispatched his coonship he gave him 20 cents to pay for his ticket. No sooner had Lige gotten into the train than he tried to conceal himself under the seat in order to avoid paying his fare.

By and by the conductor came along and saw Lige's heel sticking out from under the seat.

"Come out of there, you black devil; where's your fare?" So Lige crawled out and handed over the 20 cents Mr. Reed had given him.

"Twenty cents!" said the conductor; "you know d——d well the fare is twenty-five."

"Cap'n Brown, ah dun tole Cap'n Reed dat de train affair hed riz, but yo see, Cap'n Reed he powful deef en he cudn heah mo'n twenty caints." DIXIE.

Machining Slot Links—Limit Gages—Hardened Pins—Piece Work.

Editor American Machinist:

As most people know who have tried it, machining a slot link is a by no means easy operation unless one has machine tools specially adapted to the work. Of course if a large vertical miller is at hand the matter is easy enough or with a slotting machine the table of which will take in a sufficient radius; but in my own shop there is nothing of the sort, so we got round the trouble in the following way: There happened to be an 8-inch gap lathe which would take in a face-plate of greater radius than the links, and for this we had a large face-plate made. Incidentally I may mention that we did rather good work with "Capital" steel on this work. The lathe has been speeded up to such an extent that its slowest speed when turning on the outside of a 30-inch job is 80 feet per minute. This steel took this speed on cast iron (English cast iron, too) with a ¼-inch cut without a trace of injury. I hardened the tools myself and did my level best to burn them in the forge fire according to instructions, "bringing them up to a white welding heat" and then plunged them right away into cottonseed oil. After finishing the above job the tool was not only in good condition, but appeared sharp enough for finishing. I believe that these tools can often be got to take a finishing edge if hardened in oil instead of air, and if once we can get high-speed steel which will take a really good finishing edge we shall be in a fair way to solving the problem of steel for lathe tools.

After the face-plate was finished, we bored a couple of bolt holes in it in the correct position for bolting the slot links on by the eccentric rod-pin holes and fixed a long piece of 1-inch gas pipe to the face-plate as a handle. The face-plate was then thrown out of gear and a boy set to handle the slide-rest while the lathe hand worked the face-plate backward and forward by hand-operating it, so to speak, planer wise. The result was perfectly satisfactory, the job being finished in very good style and with a surface which left little draw filing. If instead of a lathe tool a milling spindle were rigged on the slide-rest better work still could doubtless be done. A further refinement could be introduced by fitting an eccentric to the back shaft with its rod gearing to a pin on the face-plate, thus giving it automatically the necessary oscillating movement.

I wonder that no one has yet thought it worth while to put a horizontal lathe on the market at a reasonable figure. You can get these machines (boring mills, they are generally called), but the price is nearly prohibitive for jobbing work, running, as it does, on to about £150 for the cheapest and smallest I have yet come across. It seems to me there is no sort of reason for this. For instance, one can buy a slotting machine of 8 inches stroke for about £60 fitted with full automatic movement to the table—that is to say, the table will move longitudinally, horizontally and with a circular motion at will. Now a moment's consideration will show that if this table were so geared that it would rotate much faster and the ram of the slotter and its gear were eliminated and a slide-rest substituted, one would have a horizontal lathe and the gear about it would be considerably less than the gear of the slotter, so it ought to come cheaper to make. I am certain that such a tool would meet with a very ready sale. I have often seen my men take the face-plate off the lathe, set the job on it on the bench and then readjust it; all this would be saved on a horizontal face-plate.

Another tool that is badly wanted is something a little cheaper and rougher than the present grinding machines. Everyone who would like to use grinders for finishing does not want to finish work to half a millionth of an inch or thereabouts, and if only one could get a grinder which could be relied on for, say, one-thousandth of an inch, it would be a blessing. As it is, it is simply prohibitive to finish long jobs of rough work on a grinder for which one has likely enough to pay £300.

I have recently tried some experiments in hole boring. I have had a lot of trouble in working to limit gages in getting the holes bored true at a reasonable cost, so I set in to try a few experiments for myself. We bored ¾-inch holes with a 47-64 twist drill and reamed them out with a rose reamer under the drill press. The reamer did not travel true, having been bent, but this did not seem to do any harm in the finished result. We tried gray iron, wrought iron and brass and tested them by trying the fit of pins turned to about half or one-thousandth of an inch small. The half-thousandth pin was a driving fit both in the brass and iron, but a loose working fit in the gray iron. The thousandth-of-an-inch pin worked in all, but was a somewhat tight fit in the brass. We then ran the reamer through the brass once again and found that it was then a good working fit. The experiments are not exhaustive enough, but I believe that if anyone cares to experiment in this direction they will find it remunerative. For instance, if one could rely absolutely on turning out the same size hole with the same tool in any material, it would greatly facilitate limit gage work. It is possible that this could be done by running the reamer once through gray iron, twice through wrought and three times through brass; as the feed can be heavy, there would not be much time wasted.

I have found the Newell limit gages a great institution. To use limit gages of the usual type in a small jobbing works is

out of the question. Not only has one to have a gage for each size, but half a dozen different limits for each size and the cost is simply enormous.

With these gages, which are a sort of double micrometer gage without an index, one has only to set the gage to any limit and give it out. To set them one brings both points to touch a standard and then screws them up by a pair of dial plates supplied with graduations, the desired number of thousandths of an inch. Thus, for a working (running) fit I find a limit of less half to less one and a half thousandths just right for work about 1 inch diameter, but it is of course not necessary to keep so fine a limit for a lot of work. I find the men get into the use of limit gages very soon and they are simply invaluable for piece work. If one sets a man a hundred cheese-head pins in the ordinary way, some of them will not go in; of the rest, you can put two into one hole, and if you refuse to pass the pins there are black looks. With a limit gage there is no trouble. No amount of profanity affects the thing, and it is understood that, to pass, the weight of the gage must take it over the first limt and must not allow it to pass the second; there is to be no forcing. These gages can easily be forced over a thing a thousandth of an inch larger than themselves, just as two men will measure a job with micrometers and call it anything, up or down of its size a thousandth of an inch, unless the micrometer is fitted with a frictional rig. I am gradually getting to have everything turned out to limit and the pleasure of boring a hole, sending the piece to store, and knowing that the pin turned by gage to fit it *will* fit it a year later with absolute certainty and precision without once having been brought near it before must be experienced to be appreciated. There is another advantage. If you let a man fit his job to its hole, he will make some of them so good a fit that the first time they go to work they will seize and it's half a day's job to get them apart; with a well-chosen limit this never happens and you never get a slack fit, either—looking like a curtain ring on a knitting needle. A well-thought-out system of limit gages with the limits marked on the drawing will work wonders in a short time.

If one adds to this the system of piece work used in this district whereby the man is guaranteed, as long as he is employed, his standard daily wage, whether he makes it or not and gets his piece work as a sort of premium, you give yourself an infinitely freer hand in setting piece rates. If you happen to spot a low rate by mistake, no one is the worse and you probably know about the minimum time for that job when you want it next time. My own idea is that every job in the shop should be set on these lines; your wage bill will be heavy, of course, but your cost will not and that's the only thing which counts. Even if the job is repairing a breakdown, there is no harm in the foreman having a guess at the time necessary, and if he is something near it the man will likely do the job in half the time he would otherwise, saving the time of a valuable machine thereby. The only precaution you have to look out for is that there is not too much time wasted between whiles, and if you clock the time automatically on the cards this tells against the foreman and he will look out that he does not have men waiting five minutes after they have a job given them before clocking it.

By the way, can anyone tell me whether a hardened steel pin working (say, one-thousandth of an inch slack) in a 1-inch hardened steel hole will seize or not? I am thinking of bushing all my eccentric pins with hardened steel bushes and using hard steel pins to do away with wear, and should much like to know if they will be likely to work. Hardened steel wrist-pins are used in automobile engine connecting rods, but, as far as I know, the connecting rods are not hardened; whether they are brass-bushed or not, I do not know. If hard pins and bushes will work they ought to last a very long time, which would be a great saving in refitting valve gears of small engines where adjustable pins are quite out of the question.

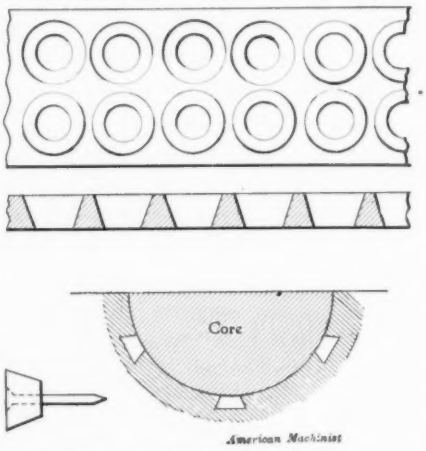
J. S. V. BICKFORD.

Camborne, England.

Cored Anchorages for Babbitt.

Editor American Machinist:

I show in the sketch a way of providing in the casting anchorages or means of securing babbitt without any drilling or



CORED ANCHORAGES FOR BABBITT.

other machine work. It may be an old way to many, but it may be new to more. A plate not over ⅜ inch thick and of any convenient size is drilled full of tapering or countersunk holes, as shown, the countersink extending all through the plate. These holes are rammed with core sand, forming little cores which, when dried, are stuck on to the body of any bearing core as shown, a ¼-inch No. 16 steel wire brad being stuck through the middle of each, thus holding it securely. No measuring and only a little judgment is required in sticking them on. These buttons are attached to the large core when it is turned out of its core box, and then all of it is baked in the oven together. The buttons are made in considerable quantities and are kept ready for use. They can be applied not only to bearings of all sizes, but also to eccentric straps and in any other places where babbitt is cast in place and has to be secured. STEVE.

What a Shop System May Do.

Editor American Machinist:

About two years ago I had occasion to take hold of a manufacturing plant, comprising machine shop, iron and brass foundries, that had been operated for years without improvements. While getting a grasp on what was required I jotted down sundry items that were desirable to be done in order to get affairs systematized. I enclose a copy herewith, thinking that it may be of interest, and open a discussion in the columns of the AMERICAN MACHINIST that may prove of real value to some. The light of two years' experience shows that a revision might be made, but I hand it to you in its original form.

A shop system shows:

(1) Shows the cost of material and labor in every machine made, and in each and every one of its component parts.

(2) Provides reliable data for the introduction of piece work or the premium plan, checking the foreman with piece prices or time limits.

(3) Shows, by plain arithmetic, how much the new machine tools, jigs, gages, small tools, molding machines, new patterns, etc., pay on their cost, and is a valuable criterion for further expenditures on similar lines.

(4) Provides the superintendent with a constant check on the foremen: always a valuable consideration, and especially so in the case of new foremen and their inevitable changes.

(5) Provides the foremen with a constant check on the production of the workmen: always a valuable consideration and an especial help in the case of new foremen.

(6) Constantly indicates the trend of costs, thereby promptly impelling the necessary remedy in case of increasing costs, and the proper reward in case of decreasing costs.

(7) Increases total output by harmonious and methodical handling of the various parts in their progress through the works.

(8) Provides written records and a perpetual inventory of the work in process in the foundries and machine shops, thereby enabling the foremen to keep track of the work and thus complete all the parts as required.

(9) Compels production of parts in lots, because it plainly shows the excessive cost of "rushing" a few parts through to "fill an order."

(10) Provides written records and a

perpetual inventory of the parts completed in the foundries, machine shop and storerooms.

(11) Provides a reliable and comprehensive means of promising shipments and meeting such promises.

(12) Provides a safeguard on accepting orders for machines that are not in the regular line of manufacture, because it shows the extra costs in the drafting-room, pattern shop, foundries and machine shop.

(13) Provides true data for promptly and correctly estimating cost of new work, without which such work generally entails loss instead of profit.

(14) Provides exact cost of new tools, jigs, gages and patterns, as well as the changes in costs of parts brought about by the use of such new appliances.

(15) Relieves each foreman of the burden of "carrying his work in his head," permitting him to use his head as an active, efficient workshop instead of a storehouse.

(16) Makes each and every workman conscious that his daily and hourly output is known exactly, and in consequence he is stimulated to put forth his best efforts in order to hold his position.

(17) Indicates the most efficient and valuable men in all departments of the works, because results of individual efforts are recorded.

(18) Provides written orders to be given by all who are authorized to give orders: thus securing exactness, fixing responsibility and eliminating all questions of veracity.

(19) Provides a perpetual inventory with costs of all small tools, jigs, etc.,

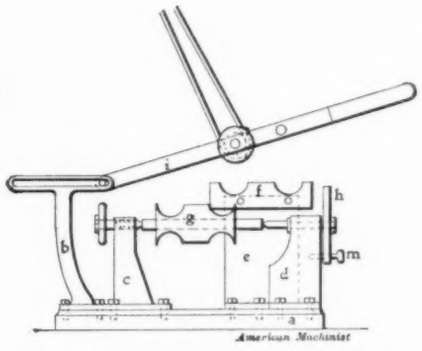


FIG. 1. RIG FOR MILLING CUTTER BLANKS.

that are frequently overlooked and known only to a "few old hands."

(20) Provides a record and a perpetual inventory with costs of all patterns and core boxes, and makes them available, not only in the foundries, but in the drafting-room.

(21) Provides a record and perpetual inventory with costs of all drawings and makes them readily available to the draftsmen.

(22) Provides the owners with exact and comprehensive written records of what their property comprises. W. S. M.

Rig for Milling Cutter Blanks.

Editor American Machinist:

Some years ago, while running the milling machine department, the firm I worked for took a contract which required milling cutters of various shapes. As we did not wish to purchase them, I was obliged to make them myself. I got up the tool illustrated to mill them. It was cheap and thoroughly satisfactory.

Fig. 1 shows a side view. *a* is a base upon which are mounted the double arm

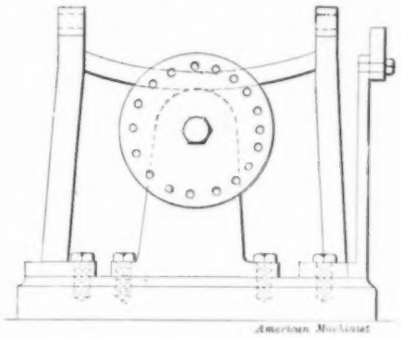


FIG. 2. END VIEW OF RIG.

b with a slide as shown, two centers *c* and *d*, a support *e* for guiding plate *f*, and a cutter blank *g* ready for operating. The center *d* has a division plate *h* and an indexing pin *m*.

Fig. 2 is a front view and is self-explanatory. Fig. 3 shows top view of arm *i* with guiding pin *j*. *k* is a grooved pulley for a round belt and *l* is the milling cutter. Plate *f* and pin *j* are both hardened. The driving belt has a balance weight (not shown) to take up slack, and counterbalance the arm *i*. J. K.

Convenient Rules for Belting

Editor American Machinist:

Sometimes it would be a convenience when asked regarding the power a certain belt will transmit or the proper size of pulleys for a certain place and you have not the tables at hand, to be able to give a fairly correct answer offhand and not guess at it and as likely as not guess wide of the truth.

A system that is easily remembered and has the merit of working out in close agreement with one well-known maker's published tables of pulleys and powers is as follows and is arrived at thus: A pulley from 18 to 72 inches diameter, of 16 inches face, for a double belt, gives approximately one horse-power for each inch in diameter at 100 revolutions per minute, the actual figures being 4 per cent. in excess.

Sizes 72 to 120 inches use 14 inches face + 4 per cent. power; the greatest variation from exact agreement in these sizes is with 90-inch pulley, giving 96 horse-power, 72-inch pulley giving 71 horse-power and 120-inch giving 121 horse-power.

For single belt pulleys of 6 to 18 inches diameter, use 20 inches face as a base for calculation, adding 4 per cent. to the power in all cases; different widths of face and numbers of revolutions are in direct proportion. For examples:

Single Belt Pulleys—16x5 inches is $\frac{20}{5} = 4$, and $\frac{16}{4} = 4 + 4$ per cent. $= 4.16$ horse-power. The published table gives 4.1 horse-power. Again 12x10 inches face is $\frac{20}{10} = 2$, and $\frac{12}{2} = 6 + 4$ per cent. $= 6.24$ horse-power. Table, 6.3.

For Double Belt Pulleys—36x8 inches is $\frac{16}{8} = 2$, and $\frac{36}{2} = 18 + 4$ per cent. $=$ 18.72 horse-power. Table, 18.8. 70x16 inches figures 72.8 horse-power. Table, 73.0 horse-power. The larger sizes are irregular, as before explained, so that no exact ratio exists, but a 96x14-inch face figures 99.84 horse-power. Table gives 101.0 horse-power.

CHARLES S. BEACH

Bennington, Vt.

[A great difference in practise exists regarding the load that is put upon belting. Many would consider that the rules given by Mr. Beach load a belt too heavily for the best results and the experiments of Fred W. Taylor recorded at page 204, Vol. XV, Transactions A. S. M. E., seem to indicate that with an oak-tanned and fulled double leather belt there ought to be 80 square feet of belt surface passing over the pulleys per minute for each horse-power transmitted, where the arc of contact with the pulley is 180 degrees. For other types of leather belts he advises 90 square feet per minute.

A rule which has been used for years and is suposed by many to be all right is to give 60 square feet of belt surface per minute per horse-power for a single leather belt. This last rule, it will be seen, imposes a great deal more stress upon a belt than Mr. Taylor considers to be good practise, but it is still far below the stress

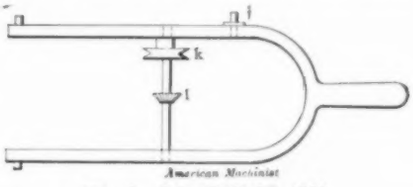


FIG. 3. TOP VIEW OF ARM.

allowed by the rule given and the tables quoted by Mr. Beach. Applying Mr. Taylor's rule of 80 feet to the last case given by Mr. Beach, for instance, we have (slide rule calculation)

$$\frac{96 \times 3.14 \times 100 \times 1.66}{12 \times 80} = 52 \text{ H. P.}$$

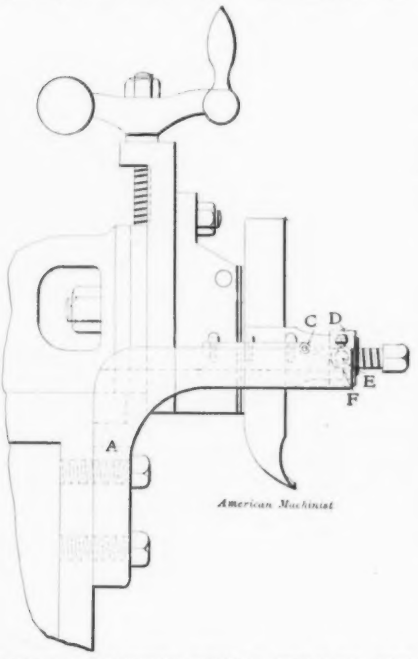
as against 100 by Mr. Beach's rule, or practically one-half the work. These are perhaps the extremes, and possibly for most cases the allowance of 60 square feet per minute or one square foot per second per horse-power for a double belt will be fairly satisfactory where the conditions are of the best. For a single belt the allowance should be a third greater, or 80 square feet, and these allowances are

easily remembered and in many cases simple calculations made from them mentally enable one to get pretty close to what is wanted.—Ed.]

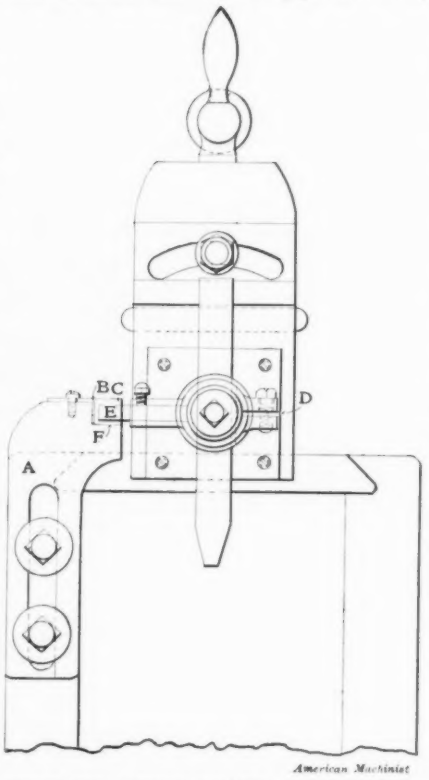
A Device for Lifting Shaper Tools on the Back Stroke.

Editor American Machinist:

Some time ago the shop where I was employed received an order for several hundred machine-steel blocks about 6x12 x¾ inch. The specifications called for the best possible finish, without any polishing or hand work, as they were to be as nearly parallel as possible. We should have machined them in the milling machine, but for the fact that there was an edge 1¼ inches thick, with a fillet which was an irregular curve and was very difficult to get with a milling cutter. After looking the job over we decided to machine them in the shaper. Here we were "up against it" again. A few tests showed us that the tool would wear so much on the back stroke that it was impossible to run over the whole surface without the tool being dulled too much to cut smoothly. It was finally decided to construct some device to prevent this, and the accompanying drawings will show how we overcame the difficulty. This simple but effective device has since become almost a necessity in this place. It is used not only in preventing a finishing tool from wearing on the back stroke, but to lift the tool out of shallow dovetails, instead of following the old practise of locking the tool down and causing it to drag so heavily as to frequently break the tool. The device consists simply of an angle iron *A* which is bolted to the body of the shaper, as shown, and is cut out on one corner, as shown at *B*. A piece of sheet steel *C* is fastened to it as shown, *C* having a hinge at the point indicated by arrow head. On the tool-post a clamping ring *D* was fitted which had a barrel on one side bored out to receive a pin *E*. On the forward stroke the pin *E* passes under *C* lifting the hinge, but on the back stroke the hinged piece, having fallen down on the angle iron at *F*, the pin rides up over the sheet steel to the back end of stroke, carrying tool-post and tool with it, when it falls down into cutting position again. We made one of these sheet-steel hinged pieces about 4 inches long; for longer work we move the hinged piece forward, and screw a piece of sheet steel on the angle iron behind the hinged piece. (The angle iron is made long enough to make this possible.) If the oil is kept out from behind the swinging tool-block of the shaper, this device will give good satisfaction.



DEVICE FOR LIFTING SHAPER TOOLS ON THE BACK STROKE.



DEVICE FOR LIFTING SHAPER TOOLS ON THE BACK STROKE.

S. HAPER.

[Some time ago we published another method of lifting a shaper or planer tool on the return stroke by means of a strap hinge or light flat spring put in at the back of the tool between the tool and tool-post, the lower end of hinge or spring projecting below the end of the tool. The hinge was declared by several who used it to be very efficient for the purpose and the cost is of course almost nothing.—Ed.]

Taking Proper Advantage of the High-Speed Steels

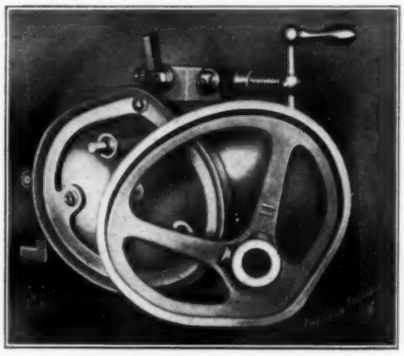
Editor American Machinist:

How many of the manufacturing establishments of this country are really saving any money in the way many of them are handling the different brands of high-speed steel? High-speed steel has been before the manufacturing public for some time, but not until quite recently has it come into general use and attracted much attention. It is, indeed, a great means of saving money if handled by the people as it should be. It has great strength and can stand what no ordinary steel could stand. You cannot pick up a mechanical journal to-day and not read of some of the marvels that have been accomplished with the high-speed steel. There is a great saving in time, but right here many close their eyes. Do they not save time at the expense of something more valuable?

A foreman in a machine shop will pick up a mechanical journal and read of the great time saved by Blank Manufacturing Company, of Somewhere. He will read it with amazement and perchance say to himself: "Well, now, is that possible? I will have to speed up the men a little to keep in line with the rest of the world." He will come into the shop and start in on Tom. "Tom, throw that belt down on the high speed and put on a little heavier feed." So he will go around from one to the other. Then he struts around the shop with a self-satisfied grin on his face and tries to make the men feel that he is of some importance about the place. He thinks he has accomplished something of note. But has he? Did he maybe speed up his men more than their machines were capable of doing, and spoil the accuracy of the machine? Most of these tests are made on "high speed lathes"—lathes that are especially constructed to stand the strain to which they are subjected; lathes with long bearings, large driving belts and heavy headstock spindles, and many other minor points that make them stronger than the average lathe. But you go into many shops and they are trying to make as good time on a lathe built fifteen years ago as they are on modern lathes especially constructed for this work. They often succeed in making as good time on rough work, but when it comes down to the accuracy of your job, then what do you have? You find that you have sprung your lathe all out of shape, strained your lead screw, and you have lost motion "to burn" all over the machine. You cannot expect to compete in "hogging" with an old lathe as your "hog." This is not only the case with lathes, alone, but with all lines of machinery. The machinery in use to-day must be redesigned to meet the demands of the times.

If you broach this subject to many foremen and ask them how about the wear and tear on the machines, they simply say that they do the work in so much better time that it makes up for this loss. But it does not, for the simple reason that they are straining every machine in the shop, and the work they do on the machines is not accurate. When it comes to assembling, or when the work goes to your vise hands, then they put in the time trying to make a job out of some fellow's "bum" work. But you cannot do this and save time: so, you see, in this way you have

a poorer lot of work turned out and a shop full of ruined machines. You go into any shop in this country that follows such methods and see if their force of vise hands has not increased faster than their force of machine hands, for the simple reason that they need more men to turn out the work in the same time, because the machine work is not properly done. What are the natural consequences of such



MASTER CAM AND FINISHED CAM.

lax methods? Why, in a short time your machinery in its output is no better than it was before, and your trade begins to fall off as a result.

Now, to overcome this difficulty, you must place a man in your shops at the head of affairs who is practical and who can improve the methods of doing work, but not at the expense of the machine's accuracy. You want a man that can design special tools, etc., and in many little ways facilitate your progress. However, if you are able, financially, buy the best machinery and then try to keep abreast with the times by employing skilled labor and employing the cheap labor for helpers. I do not think much of the management of a man who has to employ cheap labor all around to make a decent showing or profit for the business. I would not employ a foreman who was always trying to grind his men down to the very lowest wages.

The time is now at hand when a man must know a little about his business in both a practical and a theoretical way. If he does not, a man who does know steps in and takes his place and he is pushed out in the cold. J. J. JENKINS.

Abbreviations.

Editor American Machinist:

I have noted with great interest the article on abbreviations at page 719, and I offer the following criticisms or suggestions:

I object to Rule 13, and believe that we should write 8 x 12 in., not 8 by 12 in.

In the list of abbreviations I think the following are preferable:

Revolutions per minute.....r.p.m.
Mean effective pressure.....m.e.p.
Diameter.....dia.

I think there should also be included:

Radius.....rad.

West Lynn, Mass. S. A. Moss.

Cam Cutting on the Shaper.

Editor American Machinist:

The following description of a device which I constructed for cutting cams on the shaper or miller may be of interest to readers of the AMERICAN MACHINIST:

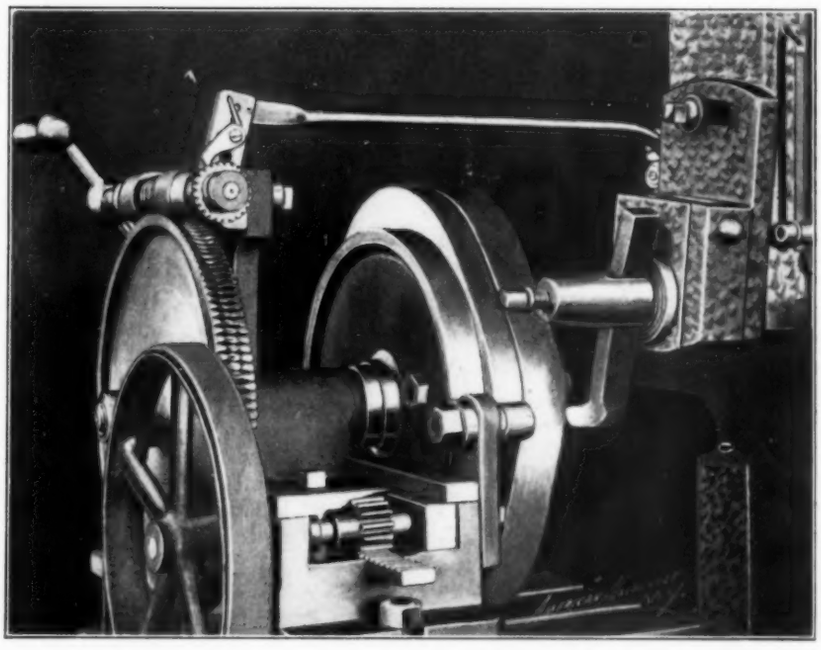
It consists of a headstock with a heavy spindle driven by worm gearing carrying a face-plate. The headstock works in a slide, on the outside of which is fastened a bracket with a roller set in line with the center of the spindle.

A master cam fastened to the face-plate is kept in contact with the roller by means of a rack and pinion arrangement operated by a weighted strap over the pulley on the pinion shaft. A stud in the face-plate locates the cam to be cut, and a bolt and strap hold it secure.

A short arm, not shown in photograph, projects from the side of the shaper ram and engages with adjustable collars on the connecting rod, operating the feed of the worm gearing. By setting the collars apart, part of the stroke of the ram is given to the connecting rod, thus obtaining any desired feed.

After roughing out the cam it is necessary to finish with a broad round-nosed tool ground to the same circle as the roller. This allows for the variation in the point of contact as the work revolves.

The spindle through headstock has a taper section behind the face-plate shoulder and is adjusted by ring nuts outside of the worm gear. A section of the headstock casting is extended upward to support the worm shaft bearing which is secured by two cap-screws in slotted holes for adjustment.



CAM CUTTING FIXTURE MOUNTED ON SHAPER TABLE.

The cam shown in photograph is part of a "full fashioned" hosiery machine. Plate cams of various shapes form a considerable portion of the mechanism of this machine, and as they may be cut on the shaper in sets or gangs, it insures uniformity in size, which is a very desirable feature in this case.

I have never heard of cams of such large size (8 inches from hub center to rim) being cut on anything but special machinery. Maybe some other reader of the AMERICAN MACHINIST will give his experience on this subject. J. WHEELER.

Germantown.

Some Shop Experience in Eye Doctoring.

Editor American Machinist:

I think many of your readers might benefit by knowing of my experience in the treatment of eyes in the shop, the removing of chips, emery, etc. In many small shops most of this work falls to the lot of one man, not by appointment or anything of the sort, but because he is considered the most successful along that line.

I very well remember that in one shop where I was employed the foreman used to be the man for this job. He would back his patient into a corner and begin work on his eyes with a scriber, making the removal of the iron or emery a very painful and trying ordeal, especially if the person's eye happened to be sensitive. I have cause to remember a superintendent who always used a knife and had a habit of trying to remove, not merely the iron chip, but also the rust spot left by the chip.

I think after reading of my experience in having a pocket-knife used on the eye many readers will hesitate before using or having a knife used for the purpose, because in ninety cases out of a hundred it is entirely unnecesary and frequently causes needless trouble.

In September, 1902, I was doing a shaper job when a very small chip of gray-iron flew into my left eye. This chip was re-

moved by the point of a pocket-knife. I presume it had been used for cleaning the finger nails, tho I cannot say. At any rate the eye became infected and a corneal ulcer was the result. Two very serious operations were necessary in removing this ulcer, and besides spending six weeks in a dark room and not being able to do any work for nearly six months, I had to have a solution dropped in my eye every four hours each day for more than a year, and I am still under a specialist's care.

Since that time in the shop where I am now employed I have been very successful in removing articles from the eye by simply using a piece of soft wood; a match with the head cut off and the stick sharpened to a very fine point seems to answer the purpose best. This is so soft that the eye is not apt to be injured, still the chip is very easily removed by it. If the eye is very sensitive, I use a drop of 4 per cent. cocaine solution, and afterwards if it is very much inflamed I use a few drops of boracic acid solution mixed 10 grains to the ounce. I simply remove the article and don't attempt to remove the rust spot which generally remains, because I find that if bothered with, it frequently makes the eye very sore and may cause trouble, while if left alone it will disappear in a day or so. F. S. C.

A Foreign Visitor with a Sketch-Book.

The vice-president and secretary of a well-known tool-building concern writes us as follows:

"We recently had a visit from a foreigner coming with a letter of introduction. We started him through our shop under the care of our superintendent. There is one certain operation which we have been particularly successful with, and it was shown him. Without any hesitancy or embarrassment he pulled out a scratch pad and sketched the entire details of *machine and equipment*, so that any draftsman could reproduce the entire mechanism. These facts were brought to the writer's attention and he was brought back without seeing any further in the shop.

"Such abuse of American courtesies, we think, would soon result in the closing of the American shops to foreigners."

The first turbine steamer to go into regular business on this side of the Atlantic is the "Turbinia," which is to make three round trips a day on Lake Ontario between Hamilton and Toronto. This "Turbinia," not the first of the name, was built at Newcastle, England, having been begun January 4 and launched on March 30. She left Newcastle June 1, sailing around the north of Scotland, and went from land to land in six days. She went up the St. Lawrence, passing through the several canals (which limited her dimensions when designed) and arrived at Hamilton June 19. She is 260 feet long and her engines are rated at 4,000 horsepower. Her contract speed was 20 miles an hour, but she made 22½ on trial.

Spongy Brass Castings.

BY C. VICKERS.

The word "spongy" applied to such defective castings describes perfectly their appearance when the skin is removed. The casting may leave the foundry apparently sound, and may have been chipped, ground and scratch-brushed until clean and presentable, without arousing the slightest suspicion that it is other than its appearance indicates. So it passes into the hands of the finisher, and the chances are that when he commences work on it, he begins where it is sound and puts in a lot of time before he discovers that the casting is spongy, and that therefore his work is all lost.

Generally the most serious loss is to the founder. He has to do his work all over again, and in addition he loses the brass turned off by the finisher, who, if he gives it a thought at all, generally regards that as a slight payment for the trouble and loss he has been put to.

The most serious loss to the founder, though, is his loss of prestige. The confidence of the customer is shaken, and for a time he regards all work from that foundry with suspicion. He is reluctant to do work on castings until satisfied of their solidity, and it does not take many disappointments to result in the loss of this man's custom, and once lost from this cause it is almost impossible to win it back.

As remarked above, some castings excite no suspicion; the holes may not show when the gates or risers are cut off, or, if they do, are so small as to pass unnoticed by the cleaner, and often obliterated altogether by the emery wheel. But though obliterated they are there, and ready to be revealed in all their ugliness by the first cut taken off. The emery wheel will cover a multitude of small sins in the shape of holes, and for this reason we can never tell by grinding whether a casting is solid.

Other castings, again, do reveal their spongy condition to the initiated when the gates or risers are cut off. In this case the holes may be large and plainly seen, forming a border, immediately beneath the skin of the gate, where it was in contact with the sand. When this occurs the casting is worthless, for if the holes are covered by hammering and "doctoring," the finishing will speedily expose the fraud.

In replacing the casting never use the same metal over again, or the second casting also will be spongy, and for the same reason as before.

In the course of my experience I have seen many spongy castings, but I never met with one that was spongy clear through. The sponginess ceases at a depth all the way from a quarter of an inch to an inch, to commence again immediately under the skin of all cored cavities. This fact for a long time led me, as it leads others, into error as to the cause of the trouble.

Naturally, under such circumstances the sand is first regarded with suspicion. It is considered too close, does not permit a free escape of the gases; yet the castings may never show a scab, as they undoubtedly would if the sand were too close for that particular casting.

The first step taken, then, is to try sand of a coarser grade, after which the castings will for a time come good, or often do. Do not congratulate yourself, though; the first thing you know the trouble will recur, as the cause has not been removed.

This time it will be the molder, as the sand *must* be all right. It is the fault of his gates, his method of ramming, or the use of sand too wet. So then you devise new methods of gating, use the sand more dry, ram it softer, and pay excessive attention to venting; and sometimes the castings will come sound, but as often not, and in the end you will have to confess all your schemes are failures, and that you are as far from a solution of the trouble as ever.

I have known brass founders who never had such experiences, but even they cannot tell when they may have, and there are many others who have. Personally, I put in many years at the business before I encountered the disease in a chronic form; then for a time I was facing a stone wall; but I finally got over.

As to the sand being a cause of porosity; if it is too fine for the weight of the casting it will "cut" and "scab," and the castings will be imperfect but not necessarily spongy. If the sand is too wet, the mold will blow more or less, according to the degree of dampness. If the metal stays in the mold it will be mixed with the sand, but that is not sponginess. Sand used too dry will not "stand" before the metal, and the metal will not stay in molds rammed too hard. Therefore if the castings are smooth and correct in appearance but spongy, there is a cause and a fruitful one; but it lies not in the sand, or the manner of gating the casting, or the ramming of the mold. All the above mentioned mistakes in constructing a mold cause gases to be generated faster than they can be carried away; such gases are outside the metal, and work havoc with the mold and not with the metal.

The trouble comes from within the metal. Spongy castings are caused by gases held in suspension in the liquid metal itself. Solidification squeezes them from the center toward the outside, but they are entrapped by the layer of chilled metal next the sand.

The castings which at one time I had trouble with were gear blanks, rolls for dies and heavy castings generally; and it made little difference whether they weighed ten pounds or ten hundred. Of course they did not always come spongy. Invariably, whenever I tried some new scheme they came all right for a while, but that was in nowise due to the "scheme" but rather to the same cause that conversely induces a piece of buttered bread to fall

tasty side down when dropped in the dust. I did not know that at the time, tho, and whenever I relaxed my vigilance, and shipped the castings without a test, back they came.

When suspicious I tested them with a chisel that I made from a square file, the cutting point of which was made semi-circular, and was thin and sharp, so that I could gouge a little groove out of the suspected casting; this always exposed holes if they existed.

I tried everything I could think of to overcome the trouble. I cautioned the furnaceman, and he was considered an exceptionally good one. I changed the sand, used facings and blackings, cast the molds in every stage of greenness, "skin dried" them and made them in dry sand. I gated them at the bottom and gated them at the top, and everywhere else possible, and used "skim gates" and "whirl gates" and "horn gates," poured my metal hot and poured it cold, and neither hot nor cold, and the result was—despair.

During all this time the melter had been under surveillance and was repeatedly cautioned against "burning" the metal. When it came from the furnaces it appeared normal, and in no case was too hot when both light and heavy castings were poured from the same pot; the light castings were always sound, while the heavy ones might be spongy, the chances being about even.

It occurred to me, therefore, that there was something radically wrong with his system of melting. What that was could only be determined by working with him. The man honestly believed that the fault lay anywhere but at his hands. He was a good man, but somewhat "set in his ways," and of course resented interference; so considerable tact and firmness was required in dealing with the case.

The whole secret lay in his method of charging a pot; and I believe the secret of all such troubles lies in the same thing in all foundries. This particular melter had the habit of charging his pot full of metal, then leaving it to melt down, and when melted he would stir, then recharge, and so on until the crucible was filled, and when full the metal was none too hot.

The mischief was done while each charge of metal was melting. When a pot is charged with cold metal the weight of it causes it to wedge between the walls more or less. The mass melts first at the bottom. By this time the upper portion of the charge is red hot and suspended above the melted metal. If we wait now for this suspended mass to melt down, the bath beneath gets overheated, or boils, and generates the gases that make spongy castings. When the suspended metal melts away at the sides, where it comes in contact with the heated walls of the crucible, it drops down into the hot bath and the liquefying cools it; so when the melter, having timed it to this stage, looks at it he sees his metal melted but not hot, and consequently he is ready to swear at any time that the metal was not overheated.

If your castings come spongy, play the detective in your melting department, look into the furnaces when the melter does, and if at any time you see the melted metal bearing on its surface the shrivelled skins of what were once gates, pieces of scrap and so forth, that metal is burned, and those skins which the furnaceman assiduously stirs into the metal are oxides, and carry oxygen into the metal, some of which is liberated as the casting congeals, causing porosity. The melting, in my opinion, is the most important operation in brass founding, and should receive much greater consideration than it usually does.

The material most difficult for a melter to use is copper wire and scrap sheet copper, because it is so easily oxidized, and because the area of oxidizable surface is proportionately so large. A slight neglect in melting will saturate the copper with oxide, making spongy castings a certainty.

In a former article I dealt with the subject of copper wire, and pointed out that it is often so badly oxidized as to be ruined before the foundryman gets it. When melting such material as wire and sheet copper, it must be constantly punched down into the pot and not left to melt at its own sweet will. Pieces of wood or charcoal must be thrown in to keep the melted surface covered and to reduce the oxidation.

Overheated metal will not always cause sponginess in small castings. If such castings do come spongy the castings and their gates should never be remelted alone, unless such sponginess is known to a certainty not to have been caused by overheating; because if it is caused by overheating it has been carried so far that the metal is practically ruined. In such a case the gates, etc., should be cautiously distributed among other heats, with the addition of a little phosphorus or other deoxidizer. If a small casting has thin flanges which rise into the cope, hard rammed sand will cause porosity in the upper part of such flange, and the remedy is easy to apply; but if the casting is spongy all over its upper part and all the castings are more or less affected, the cause is *overheating and that only.*

When a fire is first started and a pot is charged, it requires no attention until the fire is well up and the brass has begun to melt. The upper portion of the charge is now red hot and must be loosened and pushed down, cold metal afterwards being filled in. From this stage until the pot is full it will require constant attention, for as quick as the upper charge gets red it must be pushed down until the pot is filled with barely fluid metal. The pot should now be raised, the fire recoked and the surface of the metal covered with charcoal, which will protect it from oxidation while its temperature is being raised to the degree required to make the cast.

Why Jim Wouldn't Go In.

Honeycroft & Bates were both practical fellows. They had a very profitable run of work in developing various new-fangled devices for inventive geniuses, besides originating many good things themselves.

They were about as unlike as any two men well could be, except in their skill as master machinists and a love for their business. They were jolly fellows in their way and would good-humoredly stand the roughest kind of badinage, but generally sent back hot shot in return.

Douglass Honeycroft was a great husky chap, brusque in manner, ready of wit, big-hearted, always in sympathy with the under dog—no matter how he got there—and a refreshing flow of strong English. He looked the typical mechanic and was proud of it in his rough woolen shirt and trousers. He always had a merry word or a hearty welcome for everyone who worked under him.

Jim Bates had the air of a sporty college undergraduate. He was polished in his manner and irreproachable in his personal appearance in the shop and out. If the day was warm he simply laid off his coat and went to work. To see him at his bench in spotless linen and looking so clean and well groomed, you would imagine that he had stopped there but for a moment to examine the piece of work in his hands. He had the apprentice boy forever sweeping up. So much was he enamored of his occupation that he bitterly resented any disrespectful allusion to it or to his skill as a machinist.

One of Jim Bates' inventions, about which his friends jollied him no little, was an ingenious fireproof jacket for firemen and to use in case of accidentally being caught in a burning building. This device was quite a hobby of Jim's and he had put into it a great deal of time and thought. He always predicted that it would do great things for him some time.

One day Joe Caldwell, a waggish fellow, who had been worsted a few days before in a witty tilt with Honeycroft, came into the shop with a serious face and said he was very much exercised over a curious dream he had a few nights before.

"It's about Douglass and Jim, and its impressions are so vivid," he went on, "that I can't shake them off. They have become a real distress to me."

It was about noontime and several of the chummy fellows had dropped in previous to lunching all together at a nearby restaurant.

"Unload your dream on us while all are at lunch," replied Honeycroft. "Come on, Jim. Here's a modern Joseph with a dream in his craw."

Presently they were seated around the table and Caldwell began:

"Well, it was this way. In my dream I found myself up in front of the Gates Ajar, but they were anything but ajar—closed up tight and bolted down. Couldn't even see through. I don't remember anything about dying, or even attempting to

get in. I was just there, taking note of what was going on. Every little while I would see someone coming up the hill, sometimes two or three in a bunch, approach the entrance and yank the bell. Presently the bolts shot aside and a gate opened slightly and the venerable head of St. Peter looked out and asked for the name and address. After a moment's consultation of a list which hung up on the wall inside, the applicant was admitted. Once in a great while one didn't get in and turned and went slowly down the hill off toward where there seemed to be a building on fire, or something of that sort, from the smoky appearance in that direction.

"After a while I thought I saw someone striding up the hill who looked familiar. He was whistling a little Sunday school hymn and appeared to be extremely happy and in good spirits. As he approached I saw from where I stood that it was Douglass Honeycroft—just from the shop, clad in his woolen shirt and trousers, looking I thought remarkably young and unusually well. He came up to the entrance, rang the bell and the gate swung open a little, the head appeared and asked, 'Name and address, please.'

"'Douglass Honeycroft from Philadelphia, formerly of New Jersey, where I'——. 'That is sufficient,' he was interrupted, and the head withdrew to consult the list. In a few moments the head reappeared: 'Very sorry, Douglass, but we cannot admit machinists. There are folks here who wouldn't like it, you know. Associations are pretty intimate in here and we have to be careful'—— and the gate swung shut and the bolts went fast again.

"Honeycroft stood apparently dazed for a moment. Then, instead of going off down the hill toward the smoke or fog, he sat down on an old stone bench not far from the entrance. He sat there a long while, sometimes with his elbows on his knees and his head resting in his hands as if in deep meditation.

"In the meantime one and another would come up the hill to the entrance and pass in and at long intervals one would turn away and wander down the hill again.

"Then in my dream I saw what seemed to be another familiar figure smartly advancing up the hill. He was in faultless attire, kid-gloved, a light cane in one hand and in the other a small satchel which looked like a diminutive fireproof safe, with a handle on top to carry it. As he drew nearer I discovered that it was Jim Bates, natty as ever and as immaculately dressed as if he were going to his own wedding. As I looked closer I found that he wore under his well-fitting coat and swell vest his patent fireproof jacket.

"Douglass Honeycroft, sitting over to one side, didn't seem to observe him until he had pulled the bell. Even then he sat still and didn't make himself known, awaiting to see him turned down as he had been on account of his calling. Presently the gate opened and the head appeared with the usual request, 'Name and address, please.'

"'Jim Bates of Philadelphia. Arrival quite untimely.' The head withdrew and after considerable delay this time, again appeared. The gate swung a little wider and the grave-voiced keeper said:

"'Walk in, James. First aisle up, second box to the right, near the front.'

"Before Jim had moved, Honeycroft had sprung to his side and exclaimed, 'Jim Bates hold on a moment. Don't you know me?'

"'Know you, my dear fellow; of course I do. I had missed you for a week and wondered what had become of you. This is an unexpected pleasure. By the way, Honeycroft, that crazy engineer in the basement let the water get low in his boiler and has blown our building into smithereens. That's what started me out on this little trip. There are a lot of others, too. They'll be coming up the hill presently, so let us get inside and talk it over in there.'

"'But they've locked me out, Jim, because I am a machinist!'

"'What!' exclaimed Jim, and he turned to the venerable figure holding the great gate ajar for him to enter. 'I would very respectfully ask Your Reverence why you will not admit my good friend and long-time partner, Honeycroft?'

"'We admit no machinists,' was the answer. 'This I carefully and sorrowfully explained to your friend, for I liked him exceedingly and it pained me to be compelled to reject him.'

"'But, my dear sir,' said Jim, "ain't I a machinist and a good one, and I am proud to say it!'

"'You imagine you are, my son, but I have investigated your life most thoroughly and I find that James Bates is no machinist and never was. Please enter, for I must close the gate.'

"'Gee whiz!' ripped out Jim. 'Did you ever hear anything to beat that? Come, Honeycroft, let us look a little further. I have an extra fireproof jacket here in my grip which you had better put on.'

"Then in my dream I saw Honeycroft and Bates walk slowly down the hill, arm in arm, in the direction of the burning building." C. M. W.

Asbestos is a physical paradox, yet one of nature's most marvelous productions. It has been called a mineralogical vegetable; it is both fibrous and crystalline; elastic, yet brittle; a floating stone, which can be readily carded, spun and woven into tissue. In Germany it is known as *steinflachs* (stone flax), and the miners of Quebec give it quite as expressive a name—*pierre cotton* (cotton stone). The asbestos mines of Quebec are the most famous in the world, yielding 85 per cent. of the entire output, Italy being the only competing country. Asbestos is flexible, non-combustible and a non-conductor of heat and electricity, and on these properties its increasing use depends.

Standard and Systematic Methods for Making Beds.*

There are two kinds of beds and generally one is called a *soft* bed and the other a *hard* bed. The former is used for making open sand castings, or without a cope, while the other as a rule must be the bottom of a closed mold. In making either soft or hard beds means must be provided to give any form that may be desired, but as a rule a bed has a level plane surface.

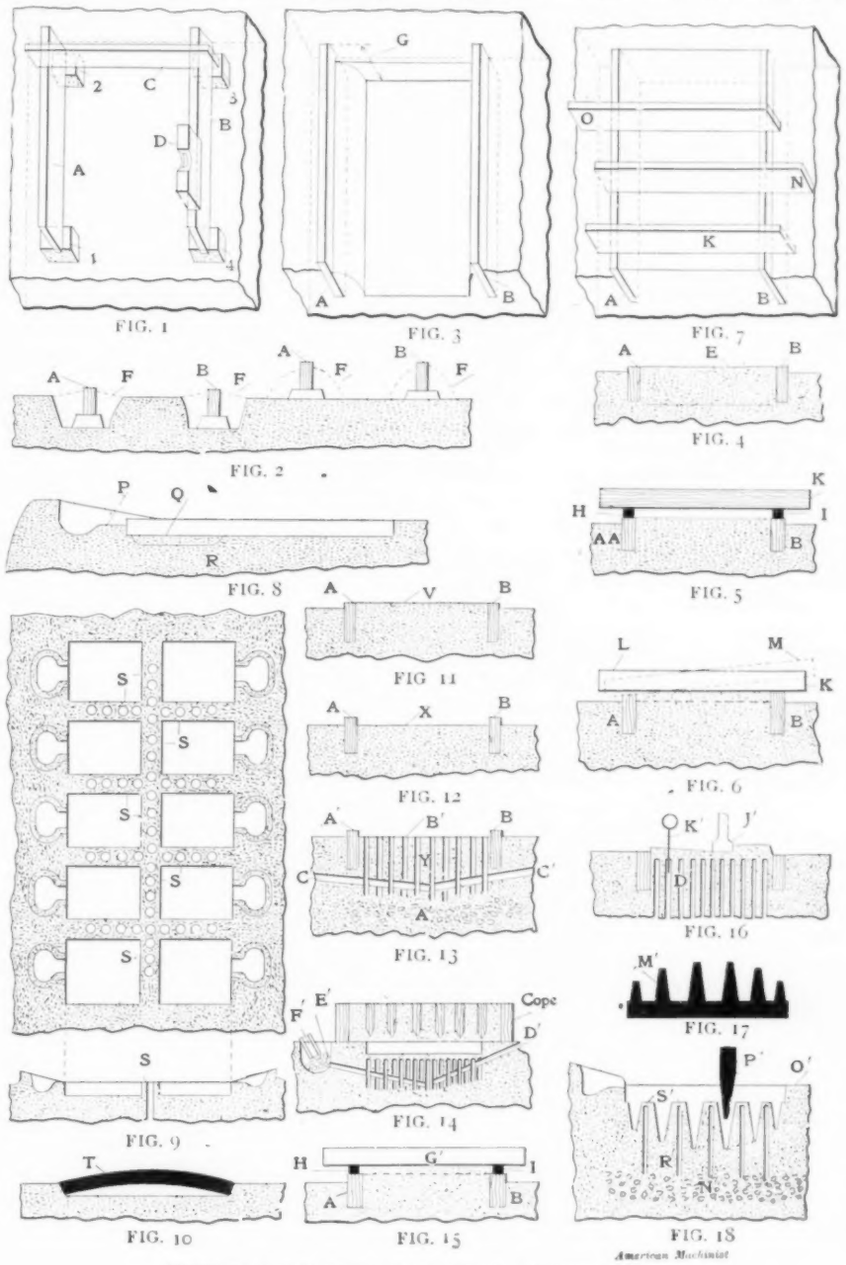
The first requisite in making a true bed is a true level. Then we require three straight edges as in Fig. 1, two of which, *A* and *B*, are true on one edge, while the third *C* is true on both edges and parallel. The straight edges *A* and *B* may be set in the floor as on the left or upon the floor as on the right in Fig. 2. They should have their ends resting on sand mounds as in Fig. 1, so that either end may be pressed down in leveling without danger of rocking. *A* is leveled first and then *B* is set on its sand mounds at the same hight as near as can be judged by the eye. *C* is then set on *A* and *B* near one end and then brought to a level either by building up more sand under the required end or by pressing the end down into the sand. The level *D* is then placed as shown and the end of *B* at No. 4 is brought to the level of the others. Sand is now filled in the vacant spaces between the mounds and tucked with the fingers to get it all as solid as this can make it. Whether the straight edges are in the ground or above it, sand is filled in on the sides and rammed as indicated by the dotted lines *F*, Fig. 2. In doing this, after first leveling the straight edges, there is a liability of getting them out of true, and hence to be assured that everything is correct the straight edges are leveled, and parts found high are pressed down by knocking on a flat piece of wood placed on the upper side of the straight edge, to preserve it from abuse. Some may lift the low end up and try to shove sand under it instead of knocking the high side down, but this will not leave as solid a bed under the straight edge. The bedded straight edges *A* and *B* must not rock; this is avoided by pounding down the middle with the last blows.

Soft beds are generally labor savers. Their use obviates ramming and venting. There are few, if any, castings made on soft beds that could not be made on hard ones, were these but thoroughly vented. In making a hard bed a rammer or the feet are used, whereas with a soft bed only the palm of the hands, a flat body, or the edge of a straight edge is employed, the latter being the one most often used. The hardness obtained is all on the surface of the bed, while a hard bed is generally softest on its face, the underlying material being more solid and often as hard as can be made by ramming.

After leveling the straight edges as seen

* Abstract of a paper by Thomas D. West, presented at the Indianapolis convention of the American Foundrymen's Association, June, 1904.

in Fig. 1, in commencing a bed that is below the floor level, as on the left of Fig. 2, we have a view something like that seen in Fig. 3, which shows sand dug out between the straight edges *A* and *B* for the required depth, as at *G*. This space is now all filled in with nicely tempered or ½-inch riddled sand and struck off to appear like *E*, Fig. 4, being careful that the sand is placed in loosely without pressing it down in any manner. Sand is now riddled on through a No. 4 sieve evenly all over the surface of the bed, to a depth of ¼ inch to ¾ inch, as may be required. Or the sand having been riddled on the floor is shoveled on to such a hight as may be found practicable. This done, "knock-down" pieces *H* and I are placed on the straight edge *A* and *B*, as seen in Fig. 5, after which a straight edge is placed on top of *H* and *I* as shown at *K*, and with a man at each side holding the straight edge in one hand and the knock-down pieces in the other, they together pull both along the top of *A* and *B*, carrying off the surplus sand that projects above the level of the tops of *H* and *I*. It may require two or three strike-off operations to obtain a full smooth surface, as the first pulling drags the sand, and often leaves unfilled sections in the bed that must be filled in with sieved or riddled sand, and which must be struck off with the strike, as suggested above.



METHODS OF MAKING BEDS FOR IRON FOUNDRY MOLDS.

The surface having been struck off, it remains to be pounded down to the level of the tops of *A* and *B*. This operation is illustrated by Fig. 6, and is done by first removing *H* and *I*, and then with a man at each end of *K* alternately lifting up one end 3 to 4 inches, and pressing it down while the other is held stationary; the dotted line, showing how the now depressed end at *L* will be lifted, as at *M*, in its turn to pound down the raised sand. As each end is lifted it is carried on an angle as far as it can go before its end would be off the straight edge to let it be pressed below the level of the bed.

In selecting knock-down straight edges, they should be taken sufficiently stiff or deep to keep them from bowing in the center while being used. The depth of the knock-down straight edge should not be under 4 inches for beds under 24 inches wide and for every foot increase in width, the depth of the straight edge should be increased 1 inch. The thicknesses range from 1 inch to 1½ inches.

Where the quality of the work demands the most perfect bed that can be produced, it is necessary to strike it off after knocking it down. In doing this the strike is given a forward see-saw motion, one that causes the strike *K* to be pulled on a slight angle to one side of the bed as at *N* and then back to the other as at *O*, Fig. 7; care should be taken to have every movement a forward one.

After the bed has been all struck off it may be a little rough, especially where coarse sands are used. In such cases a thin covering of sand, not more than 1-16 inch thick can be sieved or spread over one end of the bed, and then by starting at this end it can be see-sawed off for a final finish.

Where the knock-down pieces have been over ¼ inch thick, the trowel can often be used to give a good finish to the bed surface, and this may often be assisted by first spreading on with the hand a very slight scattering of fine sieved sand over the surface of the bed.

Regarding the size of the knock-down pieces to be used for a given piece of work, no rigid rule can be given. It depends largely upon the character of the castings to be made and the kind of sand used. For the same cross-sections, one having a coarse grade of sand might use a ½-inch knock-down piece, whereas with fine sand might require ¼- or ⅛-inch pieces only. The thinner the castings the thinner the knock-down pieces to be used, as a rule.

It is to be understood that by using the depths of beds or loose sand here spoken of, no venting is required, but where it is practicable to lay ¼-inch vent rods 3 to 4 inches apart on the solid ground to reach under the entire bed and put 1 inch to 2 inches of sand over them before shoveling loose sand to fill in the bed, the depth could be decreased.

The greatest difficulty in using soft beds lies in the liability of the metal to leave the runner at *P* and to cut and wash away the soft sand fronting it at *Q*, Fig. 8. In beds above 4 feet square it is generally a good plan to cut out a portion of the bed fronting the runner *P* for a depth of about 2 inches above *R*, and then fill this up with all new or facing sand packed down with

the palm of the hand to the consistency of a hard bed. After this the part in question is vented with a ⅛-inch wire downward, and below with a ¼-inch wire to catch their gases. The top of the cut-out portion *R* is then struck off and finished to correspond with the adjoining level. This allows the portion fronting the runner to stand very rough usage when pouring large plates, and gives them as smooth a surface at this point as is obtained over the general face of an open sand casting. Where this method is adopted very coarse grades of sand can be used for the balance of the bed other than that fronting the runner, which is very desirable for making large plates.

A molder may wish to make a number of fair-sized plates with a partition of but 3 or 4 inches between the edges, as seen at *S*, Fig. 9. In such cases it is generally advisable to run down a ¼-inch to ⅜-inch vent wire between the edges, as seen by the holes shown, or the plates poured last may draw the gases from some that have been poured and thereby raise the center body of the plate casting while in a semi-molten state, making it appear something like the one seen at *T*, Fig. 10. The above work of down-venting may be avoided by having extra depths of loose sand under the face.

Any sand forming the face of the plate mold, be it open or closed, should be worked as dry as practicable. In making plates over 1½ inches thick, it may often be necessary to use a facing sand to assist the dusted blacking, or graphite, to peel them. In using any facing sand over the general bed it is put on the thickness of the knock-down pieces *H* and *I*, a plan which insures its being of even thickness all over the bed. As a rule, facing is not used on open sand plates unless they are over 2 inches thick. Blacking, graphite, soapstone or lime dusted over the face of any all-common sand beds will generally peel entirely when under 2 inches thick, unless it be the body fronting the runner, where a little facing sand can be used, as shown at *Q*, Fig. 8, to help the blacking, etc., to peel the casting. Then, again, a good coat of these materials fronting the runner may often answer the purpose of facing sand at this point, providing that there is not too large a body of metal washing over it. The metal to run open sand castings should be very fluid and with good life, as dull, sluggish metal cannot give good open sand plates.

There is less uniformity in the practise of making hard beds and for this reason there is special need of standard or systematic methods in making them. Hard beds are necessary where a mold has a cope, as this creates a pressure not met with on the face of the open mold. Were one to pour an open sand plate made bed with a cope on it, the casting would come out much thicker than its pattern, especially in the center.

The hardness in the face and under body of a hard bed will depend upon the speed of pouring, and the pressure when the mold is filled. As a rule, the face of a hard bed should be much softer than the under body. It is only in cases where the bed is covered rapidly and a heavy pressure is brought upon it, say inside of 5 to 7 seconds, that it is safe to have the face of the bed so hard that it requires a pull of 20 pounds to penetrate it ½ inch.

A system that could be adopted universally is illustrated in Figs. 11 to 15. Here at *A* and *B*, straight edges are leveled on the plan shown by Figs. 1 and 2, for making soft beds. This done, sand is filled in and rammed up solidly to the top, as seen at *V*, Fig. 11, after which a strike is used to lower the rammed body below the level of the straight edge to a depth of ½ inch to 1 inch, as may be desired, to appear at *X*, Fig. 12. Up to this level the degree of hardness desired is regulated by the power upon the rammer, and it may be rammed so hard that it will be difficult to penetrate it with a vent wire. In no case, however, must venting be omitted, and, as a rule, the harder the ramming the closer and the more the venting required.

In venting the body *Y*, as shown between the straight edges *A* and *B*, Fig. 13, the vent wire is driven down to the cinder bed as at *A'*. These vents should not be over 1½ inches apart, and they make a vented bed appear something like the surface at *B'*. Where cinder beds are not employed as in *A'*, then it becomes necessary to connect the down vents *B'* with under vents as at *C'*. These under vents may not be driven until after the bed is completed, straight edges pulled out, and the cope rammed up ready for lifting off. In many cases these under vents may be brought up to the joint of the mold as at *D*, Fig. 14. Then, again, a recess may be made in the floor and filled up with fine coke as at *E'*. After this the recess and coke are covered up with sand and the vent is brought to the surface with gates as at *F'*, or vents are driven from the floor's level down to the coke.

Returning to the compression or ramming of the sand, we are carried back to Figs. 12 and 13. Here the distance between the face at *X* and *B'*, respectively, and the top of the straight edges *A* and *B*, is to be made or rammed in a manner to carry the molten metal without bubbling or boiling. The bed having been vented as at *B'*, Fig. 13, the first operation is to close up the top of the vent holes by rubbing the palm of the hand over them. This done, sand (which in the case of heavy plates or special light work may be a facing sand) is shoveled on to project ¼ to ¾ inch above the tops of the straight edges and then struck off with knock-down pieces *H* and *I* and a strike *G'*, as at Fig. 15, after the manner given for making the faces of soft beds. The thickness of the knock-down pieces *H* and *I*, and the depth of the rammed face, which is the thickness of sand ranging from the bottom at *X* to the top of the straight edges *A* and *B*, Fig. 12, is what regulates the hardness of the face of the bed. The less the depth at *X* and the greater the thickness of the knock-down pieces the harder the body forming the face of the bed.

Aside from the methods shown in Figs. 11 to 15 we have the butted face bed. A bed of this class is made by first ramming up to the level of the top of the straight edges *A* and *B*, as at *V*, Fig. 11, and then striking it down from ½ to 1 inch, according to the depth of good common or facing sand required, as at *X*, Fig. 12, after which the body is closely vented, as at *B'*, Fig. 13. This all done, the tops of the vent holes are closed with the palm of the hand and riddled sand shoveled on and struck off as at *G'*, Fig. 15. The depth of the pieces *H* and *I*, Fig. 15, should be fully 1¼ times that of the struck-out depth *X*, Fig. 12. After the common or facing sand is struck off, the butt end of the rammer is used as at *J'*, Fig. 16, in a way to ram down the face in a regular even manner to obtain any degree of hardness desired. In butt ramming such a surface, care must be exercised not to miss a spot and to avoid going over the same place twice. The butting all completed, a ⅛-inch vent wire *K'* is used all over the face to drive vent holes into the main body 4 to 6 inches deep, so as to have the face gases find relief through the body vents which will connect with the cinder bed *A'* or under vents *C'*, as at Fig. 13. It is to be understood that one is not expected to have *K'*, Fig. 16, find an under vent hole every time it is driven down as at *L'*. If *K'* never struck an under vent *L'*, the gases would still be able to escape to the under vents *L* by reason of the porosity of the sand, especially if the under vents are, as they should be, not over 1½ inches apart.

The surface venting finished, the face of the butted bed is struck off smooth in a see-saw manner, after which sand is sieved or scattered sparsely over the surface with the hand and then rubbed down with a smooth, hardwood block about 2 inches thick and about 3x8 inches. This surface is in turn sleeked over with the trowel, and the bed is finished.

In venting butted faces or beds, some will dispense with the use of the second vent wire *K'* and vent direct from the butted face down to a cinder bed *A'* or under vent *C'* with a large vent wire, and then stop up the tops of the large holes left with the end of the finger. This is objectionable for the reason that finger poking can close the tops too far below the surface and, should any be missed or not closed tightly, the melted metal could escape to the cinder bed under the vents, thereby causing boiling, scabs, or a "blow-up."

Plates used by the molder to carry hanging bodies of sand or loam require for their casting beds most difficult to make. These call for prickers which in some

cases are very long. At *M'*, Fig. 17, is seen a long prickered plate, and to cast this successfully, if long, requires careful manipulation to prevent the center of the bed from lifting or blowing. The difficulty lies first in the necessity of having the bed soft enough to admit of driving long prickers into the sand and at the same time not so soft that the pressure at the bottom of the prickers, when pouring the plate, can strain sufficiently at the bottom to lift up part or the whole center body of the bed, and secondly, in the excess of gases created by the fact that the long prickers often more than double the area in which to create gases.

In making long prickered plates it is generally the safest plan to place a cinder bed under the mold, as at *N'*, Fig. 18. After the cinder bed is in place, nicely tempered sand, dry as can be worked and riddled through a ½-inch or No. 2 riddle, is shoveled into the hole in about 4-inch courses at a time, until within about 6 inches of the face. These courses are pressed down with the palms of the hands, or by securing boards about 6x12 inches to the feet and walking over the soft sand as one would with snowshoes on soft snow. To tramp about without such boards would make the bed too hard. The last 6 inches of the depth of the bed is made after the system of making soft beds.

The bed made and sides formed, the next operation is knocking down the pricker patterns *P'*, of which there should be four or six, so that the knocking down of one pattern cannot burst the sand through to any holes or prickers that have been formed by the withdrawal of a pattern. When all of the pricker patterns are in the bed, the space between them is closely vented with an ⅛-inch vent wire from the face of the bed down to the cinders, as at *R'*, care being taken to avoid placing any vents so near to a pricker pattern as to permit the metal to burst through to them and thereby run into the cinders, filling the space for release of gases. In venting between the prickers the tops of the vents will require to be stopped up by pressure of the finger, and after filling the depression with sand, the body is sleeked over with the trowel. In doing this part of the work, care should be taken to close the top of every vent hole and also not to make the surface any harder than the knock-down pieces used would leave it.

Another point well to refer to here is the danger of metal cutting in front of the runner, especially in large prickered plates. To prevent this the surface fronting the runner is best made entirely of new or facing sand, after the plan at *Q*, Fig. 8, and as an extra precaution should be surface nailed. Then, again, it is best to make the runner where it passes the metal to the mold fairly broad, as a narrow runner at this point confines all the cutting action of the metal within a narrow space, thereby giving a chance for injury to come quicker than would otherwise be the case.

Foreign Markets for American Machinery.

Every indication points to the fact that electric lighting is becoming more and more popular every day in the principal towns in Egypt. Most of the large German electrical firms are represented throughout the country, and of late years they have been fairly successful in securing some very good contracts. They quite naturally oppose very energetically the entrance of any likely competitors. The French Gas Company at Alexandria supplies most of the power employed, and they have obtained a long lease of the right for many years. There are, however, a good number of British and German dynamos employed in various establishments and private houses. There is a steady demand for electric fans; the bulk of this trade is now in the hands of American firms. The most popular fans, and which find the quickest sale measure 12 to 15 inches in diameter, revolve under a current of 100 volts and make 400 revolutions per minute. They can also be regulated to three speeds. The prices vary from $20 to $25 each, delivered c. i. f. Alexandria, duty paid. It would certainly be well worth the while of American manufacturers to study the wants of the Egyptian market in this as well as in other lines of hardware and machinery, there being a capital opening in the principal towns.

Another market which might be more thoroughly exploited is that of Fernando Po, where there is a steady demand for iron work, bridges, rails, iron portable buildings, etc. The country is now enjoying a period of exceptional activity, new lines of communication are being opened, and important public works started. There is an ever-increasing demand for agricultural machinery, and especially for implements used in cocoa and coffee cultivation which is extending throughout the island. As regards farm implements and allied goods, I may add that your dealers have secured the bulk of the trade, but there is a steadily increasing market developing every year.

I do not know if any of your readers are makers of power presses used in button making. If so, they should endeavor to secure the business that is to be had in Tokyo, Japan. In that country it is the general rule to make buttons of various kinds by hand, but as their demand is increasing day by day, stamping machines are beginning to be wanted. One of the largest button makers there is Mr. Fukutaro Funaoka, proprietor of the Funazuka Iron Works, of Tokyo. He has just purchased an adjustable power press from an English firm. It is a trial order, and if successful orders will follow from many people engaged in the same line of business in Japan.

British exporters are grumbling at the continual imitation of English trade-marks in South America, but as lawsuits are very costly and tedious these things are put up with as long as possible. Apart from this manufacturers who wish to do a good business in the River Plate will find it best to appoint really trustworthy agents in Buenos Aires with an exclusive agency, for quite three years, for the whole of Argentina, Uruguay and Paraguay. It is necessary to grant an exclusive agency, provided you secure good people to act for you. Importing houses cannot be expected to push goods, spend money in various ways, prosecute imitators, etc., unless they are themselves adequately protected from outside competition in the sale of the article in which they deal. An enormous quantity of manufactures is imported every year into South America, imitations of British goods. Most of the so-called English cutlery is German marked with a British name that has no existence. English makers find that German competition is about the severest they have to encounter in the inferior lines of production, while the United States are the most dangerous in the better class goods. In Paraguay there is not a single wholesale import or export British firm, while there are many such of German nationality.

It must be satisfactory to your locomotive builders to hear such excellent foreign commendation of the engines they have supplied to the Brazilian railroads. These locomotives adapt themselves very well indeed to the railway lines of that country, the majority of the engines being supplied by Baldwin, Brooks, and other United States houses. The Belgian experts who have been to Rio speak highly of the locomotives. F. C. C.

The Association of German Tool Manufacturers have urged the Imperial Government to prevent the further inroads of American manufacturers upon their special branches. It is claimed that in the first quarter of this year the import of tools had more than doubled, having increased from 245 tons to 526 tons, and that in the second quarter the increase threatens to become even larger. They make a special point of the fact that the United States Government levies a tax of 45 per cent. on German machines, against the German tariff of 5 per cent., and they insist that German machines are in no wise inferior to the American and that there is no need whatever for the introduction of American machines and tools into Germany.

Billy was operating a locomotive in the capacity of engineer and Mike was firing for him. Mike was ambitious and often looked the locomotive over to find out if anything was wrong with it. Just about Christmas one year, Mike crawled down around the engine and came out, very officious, and said, "You have got a crack in your truck wheel," and the engine was taken out of service and Billy missed the run out, but he got Mike in a corner and said, "You blanked idiot, what did you go poking around that wheel for? I was saving it for Christmas for a lay-off."—*New York Railroad Club.*

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Dividing Up Our Business Discomforts.

It is one of the most unsatisfactory features of the lines of business in which we are most interested that the demands for their products are so fluctuating, and that it is so practically impossible to maintain a uniform output or to provide constant employment for an unchanging number of employees. In some lines of manufacturing there is a heavy dropping off of work every season; other establishments only acutely feel such depressions at more remote periods, when, for instance, for reasons that are only partially explicable, things through the country generally get going the wrong way and one thing leads to another and one man discourages another, the resulting derangements often being vastly disproportionate to the initial cause of the trouble. When these times of temporary discouragement and of abnormal business caution occur there are certain lines of business which are especially affected. It is usual in this connection to specify the lines which cater to our luxuries and whose products can be dispensed with, and which often are so dispensed with for a time, while the recuperation of the purchasing powers of the community is being effected. There are, however, other lines which have to do with our necessities rather than our luxuries which also are made to suffer no inconsiderable inconvenience. Our railroads have a way at times of curtailing their expenses below their normal needs, and then those who produce materials and supplies for their regular operations, for repair and maintenance and for enlargement and extensions, find their market seriously curtailed and the working speeds of their business organizations interfered with. It is no evidence of serious business derangement, for instance, and carries little suggestion of long-continued business depression, when the Baldwin Locomotive Works must perforce let the world know, as it does by the wholesale discharge of its employees, that the railroads are ordering fewer locomotives than they have been doing for several years preceding. The demand for locomotives has not in the least diminished, and if for one year fewer are bought it is very certain that more than the average must be bought in the years that are close ahead. It is the same with steel rails and other products of steel. The demand for them is as certain, but not as uniform, as for bread or beef or beer, and the only difference is that, while we must have our bread or beef or beer (some of us) every day, we can wait a while for our locomotives and our cars and the rails to run them on, so that we get them all in the long run.

When it does occur, however, that large manufactories must reduce their operative forces on account of the temporary damming of the flow of orders there are still different ways of doing it. We have not a word of criticism to offer as to the action of any individual establishment. Each knows and each alone knows all the conditions upon which its prosperous existence depends, and each alone is competent to determine what it shall do to secure its own safety. The most obvious thing to do, and the thing which is perhaps most frequently done when the work slacks, is to discharge enough men to allow those who are left to be still fully employed. This is to the looker-on and to everyone who thinks for a moment on the conditions of the workman's life a most serious thing to do. There are few beings on earth in these days of advanced civilization more helpless than a modern workman and those dependent upon him when the opportunity to earn his own living is cut off. There are employers enough who think of these things, as we well know. We could tell of one employer who exclaimed to his foreman with tears in his eyes, "My God, I can't tell those men that they can't work here any more because I have nothing for them to do," and who made great and unrecovered sacrifices to keep the works going. The great objection to discharging some and keeping others, both being nearly equally deserving, is the injustice of it. Besides that, there is every business reason for the other course which is open to most businesses, and that is to reduce the running time and retain as many men as possible. This distributes the discomfort equally among the men and leaves the force fully organized for full production when full business activity is resumed. We can read with very different feelings the announcement from the one shop that it has discharged a half of its men and from another that it is running half time, and it means vastly different to the employees in the present and to the employer in the future.

No Syndicated Articles Wanted.

It has happened several times lately that we have received contributed articles which at the same time or soon after were sent in duplicate to other journals, and in one instance at least published on the same date of our publication. We take this means of saying to our readers and contributors that we do not invite letters or articles that are to be sent out in this way. We do not wish to publish articles that are to be published in any other journal at the same time, except by special arrangement, nor we do we know of any other technical journal which invites articles or publishes them upon that plan. Mechanical journals have not yet adopted the syndicate article practise as followed by some daily papers and are not likely to do so. We invite contributions that give information of value to those who are in any way concerned in machine construction, and we pay for all such articles as we can make use of, but this payment is made with the understanding that the articles paid for belong to us and that no other journal has a right to publish them without credit to us.

It has happened that a contributor, having sent us an article and not having seen

it in the paper as soon as he thought it ought to appear, has, without inquiring of us, or notification of any kind, assumed that we had rejected it and thereupon sent it to another paper. This we consider a breach of faith.

We take up for consideration all articles received as soon as practicable, and either start them on their way towards publication or return them to the writers. If there are those who cannot wait for us to do this but must fix their own time for the appearance of their articles, or must have them examined at once and a decision rendered, we do not invite contributions from such persons. In most cases no great delay occurs in either publishing or returning manuscripts, but when it does occur we cannot help it and contributors must simply wait until we are able to report.

All About Injunctions.

Many of our readers are interested one way or another in the question of injunctions, especially those which relate to labor difficulties. On the principle that it is always wise to "hear the other side" we advise such readers to obtain a copy of the "Complete Hearings before the Committee on the Judiciary of the House of Representatives" on the Anti-Injunction Bill. At this hearing both sides—those who advocated the bill and those who opposed it—were fully heard and their remarks are, in the volume before us, printed in full so that he who wishes to do so may consider, carefully the arguments on both sides. It is a very important question and he who wishes to be intelligent with regard to a matter which many of the best minds look upon as being fraught with great possibilities for good or evil to the commonwealth may well give it some careful attention. We presume the book can be obtained free by any citizen by applying to his representative in Congress.

Announcement is made that the Baldwin Locomotive Works, of Philadelphia, is to temporarily reduce its working force to about 6,000 men. The record of the establishment for the six months just closed is not one to be ashamed of even for that great concern. For the half year 905 locomotives were turned out of the shops, against 1,000 for the same period in 1903 and 694 in 1902. The value of the last six months' output is approximately $13,575,000.

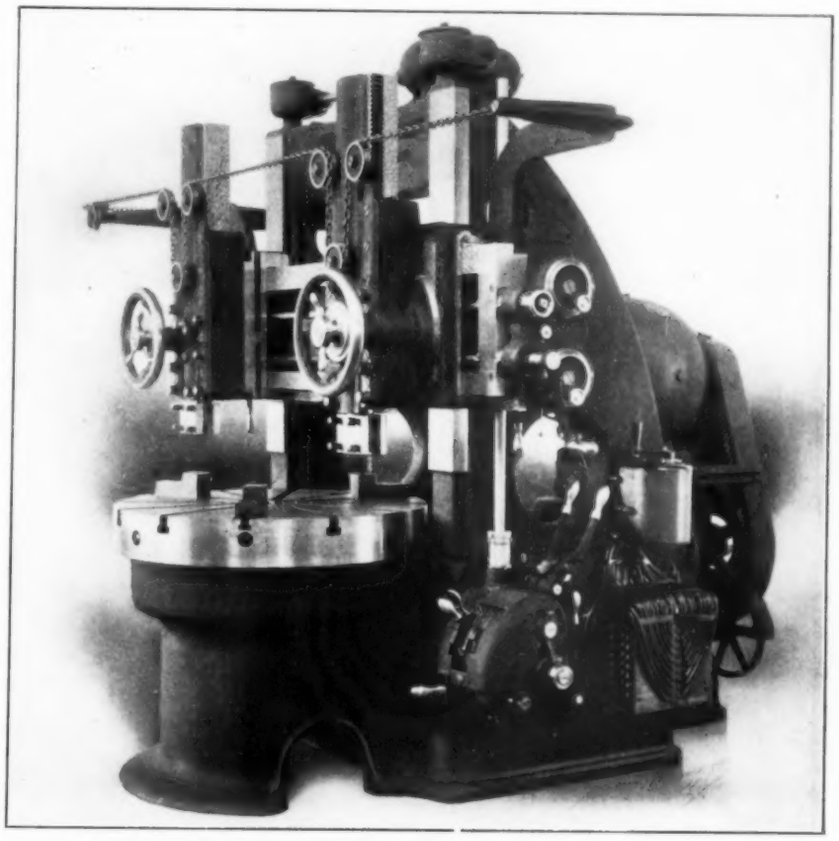
Col. Albert L. Pope, of the Pope Manufacturing Company, expresses the belief that business in automobiles for this year will amount to about twenty-four million dollars; that this is about twice the amount for last year, and that it is expected the business will grow. His company intends to build and equip several new factories, and special attention is to be paid to the development and the introduction of business vehicles, particularly such as are used by retail merchants in delivering goods.

Some New Things.

GISHOLT BORING AND TURNING MILL.

We give herewith a view of a boring and turning mill that has recently been brought out by the Gisholt Machine Company, of Madison, Wis.

The headstock is of the friction class, back geared, and giving six changes of speed; the table having twelve speeds. Levers within easy reach of the usual position of the operator make these changes almost instantly obtainable, and the machine may be stopped or started from either side on which the operator may happen to be. Through this form of headstock the table may be started or stopped entirely independently of the driving mechanism, or, if it is desired to rotate the table a small fraction of a revolution, it may easily be done without pulling the belt by hand. The adaptation of this friction form of headstock to larger machines was so successfully demonstrated by this company in its turret lathes that its adoption in the boring mills was a natural consequence. The mill is adaptable to motor or belt drive, no additional floor space being required for the former style of drive, the motor being mounted directly on the headstock, as shown. A variable speed motor equipment with an increase of 50 per cent. above normal is sufficient to give a complete arrangement of speeds. There is no cone pulley in connection with the driving mechanism; the single pulley constant speed style is employed.



GISHOLT BORING AND TURNING MILL.

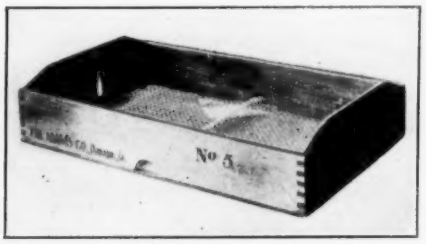
Ten changes of feed are given by this machine. The heads are entirely independent of each other and are controlled by feed mechanism located on either side of the machine. All feeds are of course operated by hand or power. The positive stop with which each head is fitted provides for bringing the center of the downslide so that it will coincide exactly with the center of the table. The downslides themselves have broad bearing surfaces, and taper gibs are provided to take up the wear. If a turret head is desired, the machines are so arranged that the right hand head may be removed and a turret head substituted in its place. The machine may be arranged so that either turret head or the regular head may be fitted with a screw-cutting device. The heads, including the turret head, may be swiveled to any angle. By a friction device in connection with the feed gear mechanism, injury to gears or to the machine, which might result from the jamming of the heads together at the center, is obviated.

There are micrometer index dials with which all the feeds are fitted. These dials read to 0.001 inch. By an automatic tripping device the feeds may be set to stop at any point desired. The feed tripping dials are located at the ends of the cross-rail and are plainly seen in the illustrations. The spindle drive is of the spur pinion variety, the spindle itself resting upon a broad self-oiling babbitted bearing. The table is fitted with three mova-

ble jaws, constituting it a combination chuck. If desired, a face-plate with independent jaws may be substituted. The machines are made in six sizes ranging from 34 to 74 inches.

A NEW MOLDER'S RIDDLE.

The half-tone shows a new riddle for molders' use, which has two or three excellent points. The shape of it is claimed to be an advantage, in that it will deliver



A NEW MOLDER'S RIDDLE.

most of the sand in the flask and not lap over at each side as the round sieve does. The iron clappers hung at each end give the riddle the necessary jar, not only relieving the molder's hands from that duty but also accomplishing the object much better. The raised portion of the wiring in the middle is very effective in crumbling the lumps, so that the sand is delivered faster and with less labor. This riddle is made by the Adams Company, Dubuque, Iowa. The usual size is 11x18 inches inside, but other sizes are made if required.

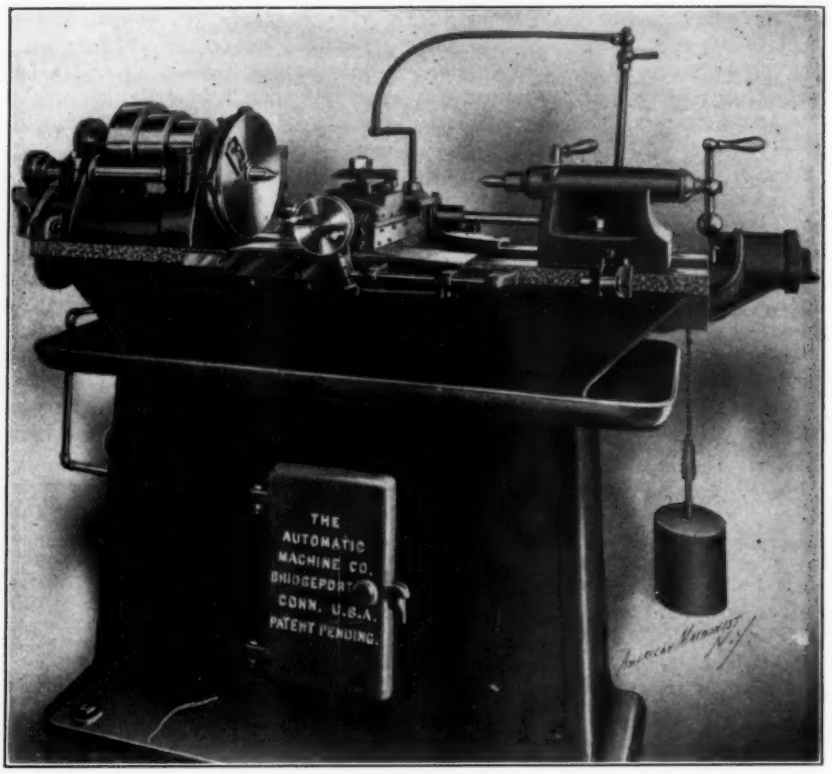


FIG. 1. AUTOMATIC THREADING LATHE.

AN AUTOMATIC THREADING LATHE.

The illustrations show a further development of the automatic threading lathe, manufactured by the Automatic Machine Company, of Bridgeport, Conn. In the lathe here described, the time usually lost in spindle reversal and carriage return, is nearly all saved. This is effected by the lead screw nut automatically opening as soon as the tools are withdrawn from their cut, whereupon the carriage returns instantly, its momentum being absorbed at the end of its travel by an air cushion which is always in adjustment for either right- or left-hand threading; thus preventing undue shock when the tools again take the next chip, and so proceed until the predetermined depth is reached, at which point they can feed no deeper.

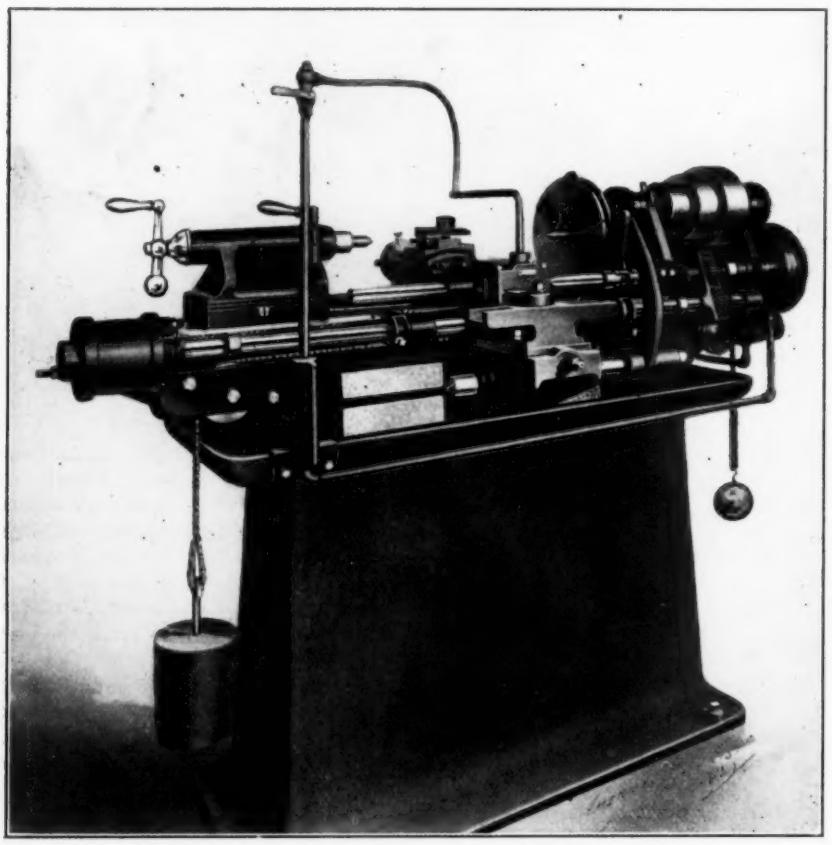


FIG. 2. AUTOMATIC THREADING LATHE.

The lathe, as shown, carries both taper and relieving attachments, being designed for tap and die threading. Threading and relieving are done simultaneously, either straight or taper, altho if straight threading only is desired, the two attachments are left off in favor of a double tool-post carriage, the tools whereon operate both front and back of the center line.

On small fine-pitched screws the saving by this method is necessarily larger than on coarse threads, but whatever the pitch or length of the screw within the capacity of the lathe, the time taken to shift from one cut to the next is never more than one turn of spindle.

The bed of this machine is 4 feet long. Swing over bed, 12 inches; over carriage, 4 inches; distance between centers, 20 inches; length of threading cut available, 18 inches.

The lead screw is located within the bed,

and provision is made for its easy removal and the emplacement of any of the several differently pitched lead screws accompanying the machine.

No attempt has been made to secure a record test, but a trial was made with the first lathe turned out, and a 1-inch pipe tap was threaded and relieved in ten minutes. A slight change in the adjustments prepares it for left-hand threading, or for internal work. Provision is also made for any form or amount of relief, and relief for any number of flutes may be formed on the work.

Referring to the sectional drawing, *A* is the tool-post operated by the cam *B* through connection *C*; *D* is the lead screw nut opened and closed by cam *E* through connection *F*; cams *B* and *E* being connected by gears, as shown in Fig. 2, act together on the cutting tool and lead screw nut; *G* is an intermediate slide carrying the tool slide and cam *B* controlled entirely by the taper attachment slide *H*. The operation of the relieving attachment is clearly shown in Figs. 2 and 3.

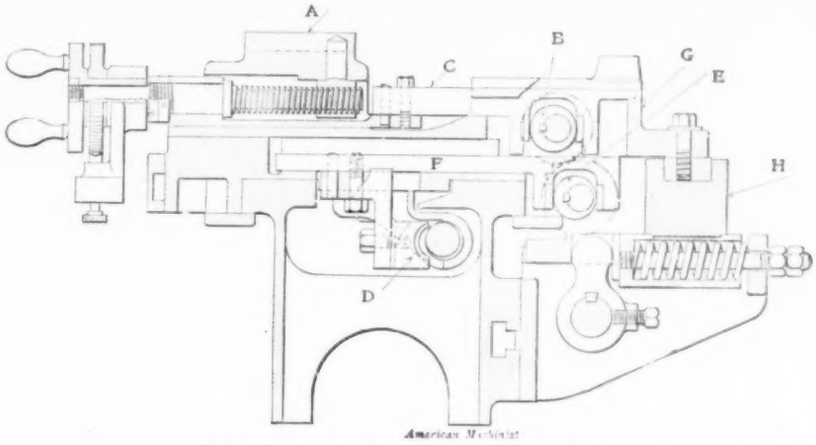
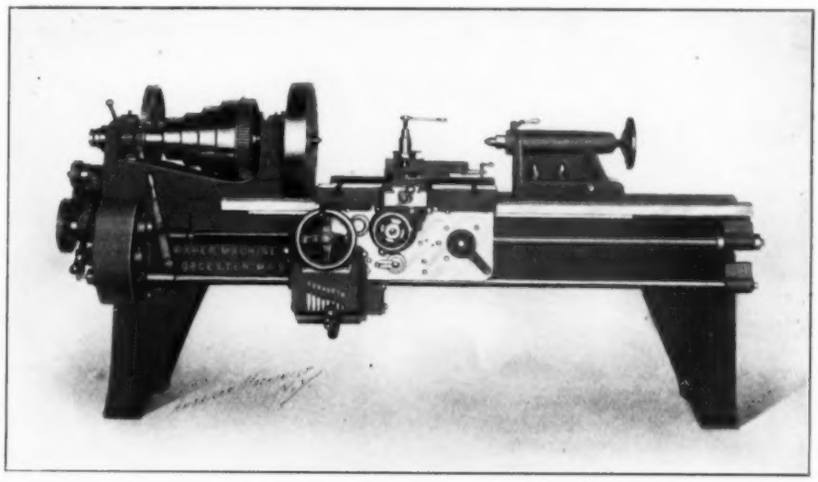


FIG. 3. AUTOMATIC THREADING LATHE.

18-INCH DRAPER LATHE OF NEW DESIGN.

The accompanying illustration shows an 18-inch engine lathe of new design, a special feature of which is the quick-change feeding device, this being adapted to give the operator command of a number of screw pitches or feed changes without moving from his position at the carriage of the lathe.

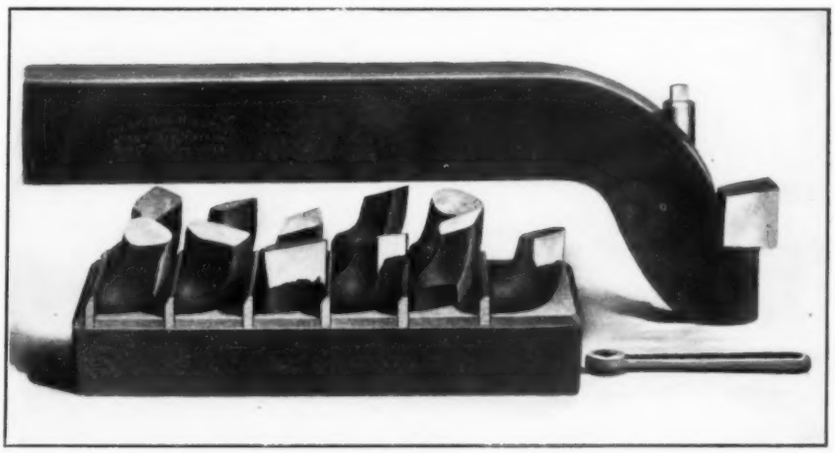
An inspection of the illustration shows attached to the left-hand end of the apron of the lathe, a gear box with a projecting handle, or sector, and a series of holes numbered from 1 to 8, inclusive. Placing the locking pin of the sector in any one of these holes gives a separate pitch of screw or change of feed, as desired, all under the hand of the operator. At the head end of the bed is placed a second gear box, which contains a supplementary change gear mechanism controlled by the two levers shown. These changes, five in number, are of such a ratio that they do not overlap the eight changes in the apron gear box. Thus there are forty distinct screw pitches or rates of feed in five groups of eight, from two to fifty-six threads per inch. The feeds, both cross and carriage, are reversed in the apron immediately at the hand of the operator, and interlocking features are provided, so that only one feed is operative at a time, also preventing the half-nut being closed upon the lead screw unless both the cross and carriage feed mechanism are placed in an inoperative position, and *vice versa*. The shafts and gears in the apron and head end gear box are made of steel, the gears being cut from the solid, and ample lubricating devices provided. This quick-change feed device is manufactured by the Draper Machine Tool Company, Worcester, Mass., and is being attached to all sizes of its engine lathes from 18 to 42 inches, inclusive.



18-INCH DRAPER LATHE OF NEW DESIGN.

PLANER TOOL HOLDER.

The half-tone illustrates a new planer tool holder and set of tools which should interest shopmen in general, the holder being forged back at the end, as shown, to bring the cutting edge of the tool in line with the back edge of the shank—a feature which all planer hands will appreciate. The tools are made of high-speed steel and each is forged with a round shank which fits a pocket formed near the end of the holder. A shoe or plug with a concave face clamps the tool firmly to its seat, this shoe being forced forward by a beveled faced binder plug operated by means of the square-head screw. By removing a small retaining screw at the front, the entire binder may be slipped out of its pocket. In using this tool holder it may be set true by the square nose and then the various tools may be used as required, and the square point finally slipped

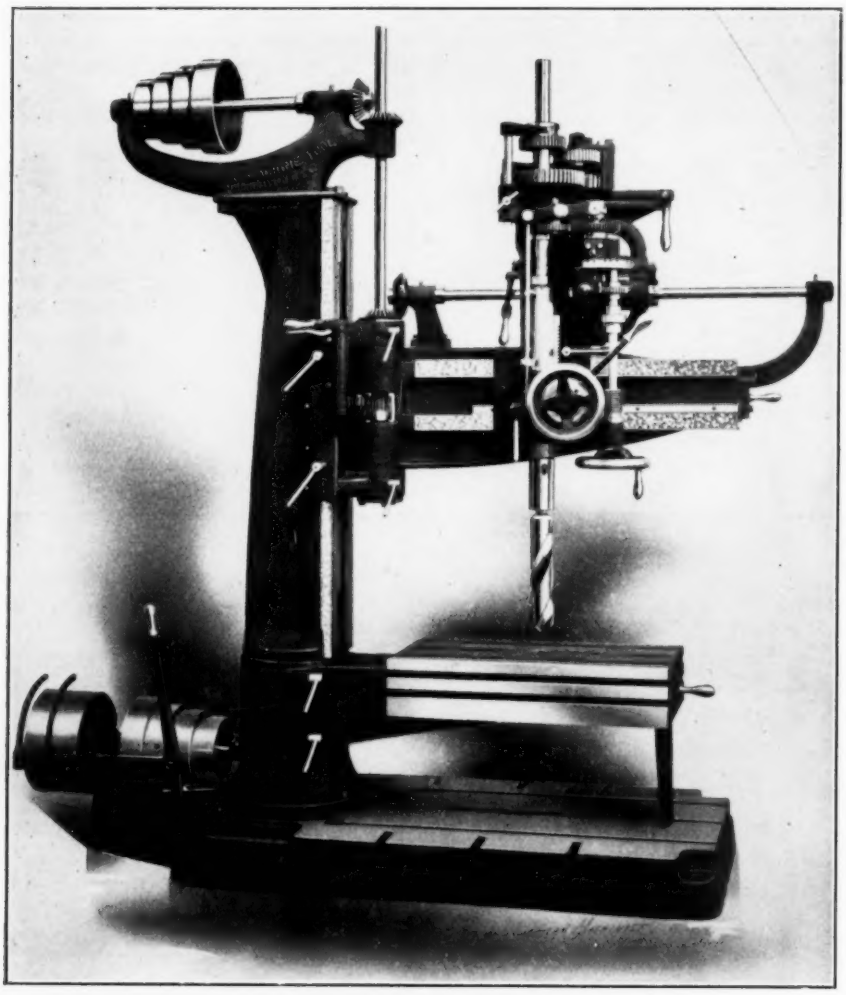


PLANER TOOL HOLDER.

back into place for the finishing cut without any resetting of the holder. In the same way roughing and finishing side cuts may be conveniently taken. The tool is made in three sizes—1x1¾, 1¼x2 and 1½ x2½ inches—by the O. K. Tool Holder Company, Shelton, Conn.

NEW STANDARD RADIAL DRILL.

The illustration shows a new 3-foot arm standard radial drill built by the Fosdick Machine Tool Company, Cincinnati, Ohio. On these machines the back gears and tapping attachments are located on the head. The arm swings on ball bearings, and is raised and lowered by power. The head is moved along the arm by rack and pinion, and is provided with clamping device. The driving pulleys are placed on side or back of column as ordered, allowing the machines to be placed either at right angles or parallel to line shaft. They are furnished with parallel drive as shown in the illustration unless otherwise ordered. The machine weighs 3,500 pounds.

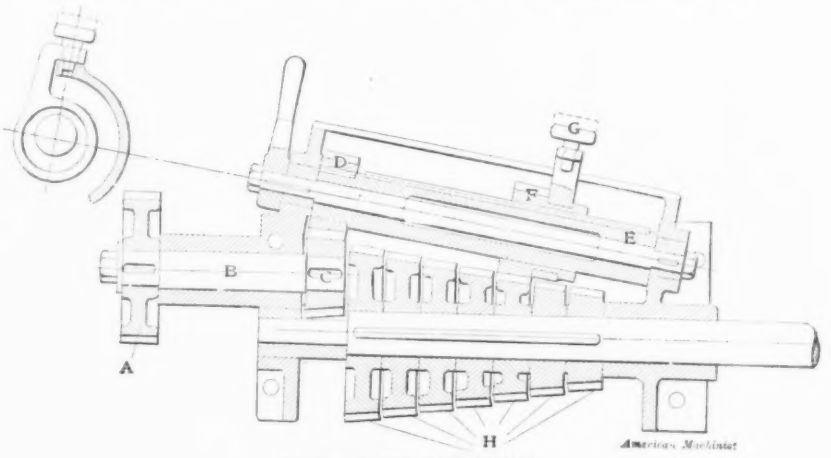


STANDARD RADIAL DRILL.

Drills to center of 72-inch circle. Least diameter of spindle, 1 11-16 inches; traverse of spindle, 12 inches; spindle speeds from 375 to 15 revolutions per minute. There are six changes of feed from .007 to .0465 per turn of spindle.

RAPID CHANGE GEAR DEVICE FOR LATHES.

This arrangement consists of a gear *A* engaging with the gear on quadrant and mounted on a short shaft *B*, which carries at its other end a bevel gear *C*. The bevel gear *C* engages with a bevel gear *D* mounted on one end of the quill *E*. The quill *E* carries a sliding bevel gear *F* which is moved along the feather on quill *E* or held in a fixed position by means of a handle *G*. The quill *E* has an eccentric at each end, and a lever at one end to throw the gears *D* and *F* carried on the quill into or out of mesh with the gear *C* on the short shaft *B* and the bevel change gears *H* carried on the lead screw.

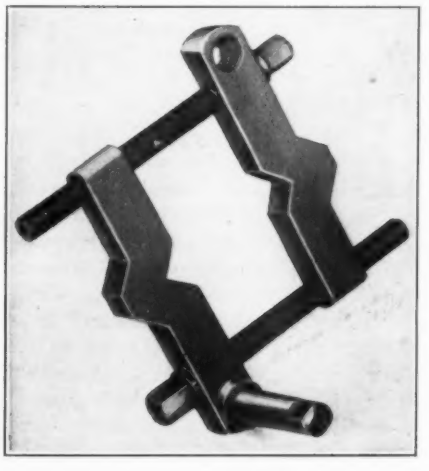


RAPID CHANGE GEAR DEVICE.

This device is applied to lathes 32 inches swing and larger by the New Haven Manufacturing Company, of New Haven, Conn.

A NEW CLAMP DOG.

The illustration shows a new clamp dog. It is at present made in two sizes, the small size taking from ¼ inch to 2 inches while the large size ranges from ¾ to 3½ inches. These dogs are very light and are nicely balanced, and in consequence are well adapted to high speed.

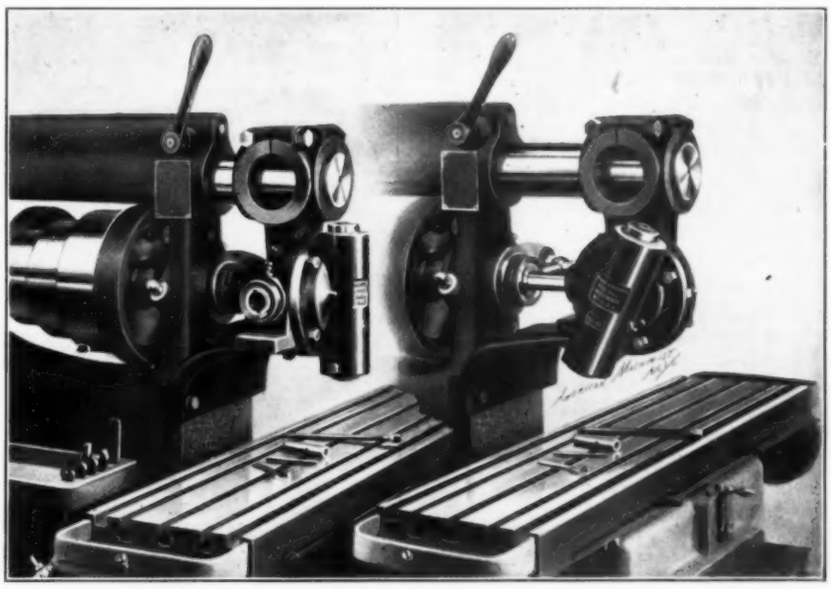


A NEW CLAMP DOG.

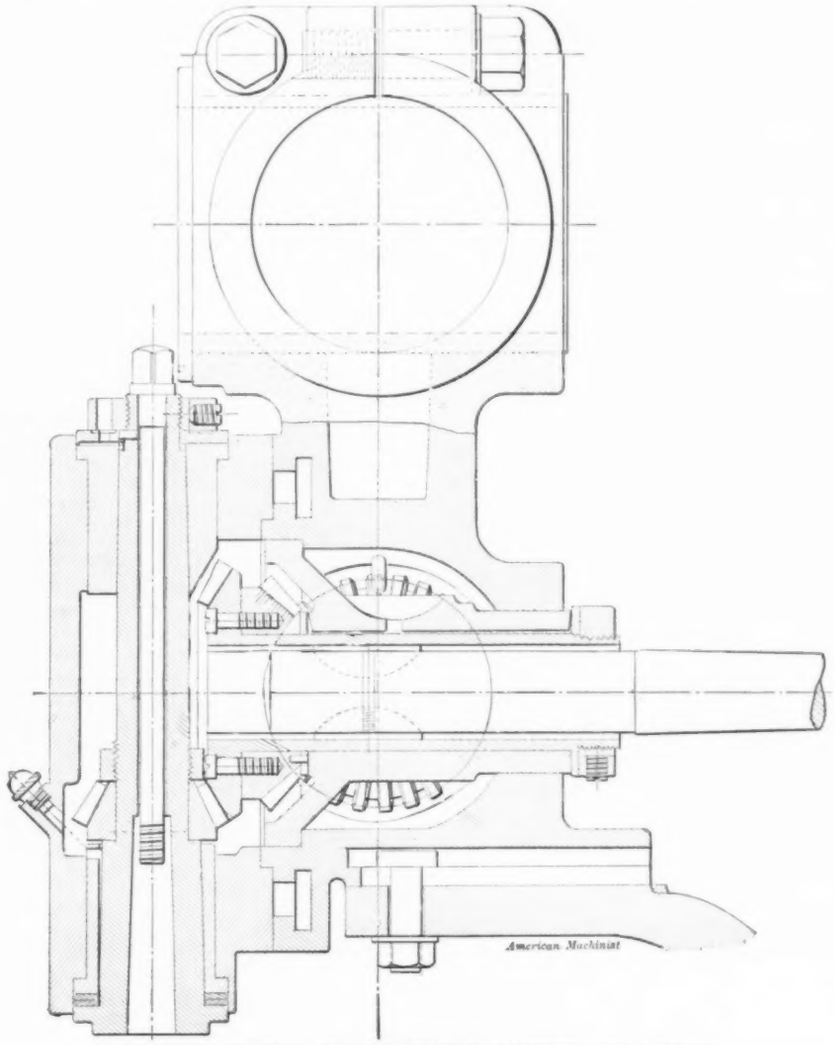
The tail is removable, and any length of tail can be screwed into the dog. By removing the tail there are two tapped holes at diametrically opposite corners. In this way it can be used for tieing work to the centers of the lathe (when using the steady rest, and dispensing with the tail center), two bolts being passed through the faceplate and screwed into the tapped holes in the dog, thus tieing the work to the head center and at the same time providing means for driving it. They are made by the Bayldon Machine & Tool Company, 18 and 20 Morris street, Jersey City, N. J.

COMPOUND VERTICAL SPINDLE MILLING MACHINE ATTACHMENT.

This attachment is applicable to a large variety of drilling, spiral milling, milling angular slots in surfaces at any angle, T-slots, keyways and work of a similar character. The upper part of the frame or head is clamped to the overhanging arm and the lower part to the face of the column by means of a bracket. The spindle is driven through bevel gears by a horizontal shaft inserted in the main spindle of the machine, and can be set to any angle from a vertical to a horizontal position. In addition, the attachment can be turned to allow the spindle to be set in a plane at right angles to the table (see Fig. 2), available for milling angular strips, tableways, etc., as with the spindle in this position the full length of the table travel is available and an ordinary end mill, instead of an angular cutter, can be used for milling the angles. The spindle bearings are of bronze and provided with means of compensation for wear. The position of the spindle is indicated by graduations on the back of the head, reading to degrees. The spindle has a No. 7 taper hole; a draw-in bolt is furnished for use in holding collets, etc., in the spindle. This attachment is made by the Brown & Sharpe Manufacturing Company, Providence, R. I.



COMPOUND VERTICAL SPINDLE MILLING MACHINE ATTACHMENT.



COMPOUND VERTICAL SPINDLE MILLING MACHINE ATTACHMENT.

Anesthetizing Metals and Things.

An extraordinary announcement has been made by M. Jean Becquerel at the Paris Academy of Sciences. The statement refers to the mysterious N-rays which are emitted by human and other living bodies, and also by certain inanimate substances, in particular by metals. Animals put under chloroform cease altogether to emit the rays. The emanation recurs when the effect of the anesthetic has gone off. Death causes final cessation of the emission of N-rays. Flowers, from which also the rays emanate usually, were subjected to chloroform and likewise went to sleep, the emission ceasing, but recommencing after a time, presumably when the influence of the anesthetic had disappeared. This is a sufficiently remarkable phenomenon, but it is nothing to the next observation reported. Similar experiments have been made with the inanimate substances which possess the property of giving out the N-rays, and, as announced in the Academy, it has actually been found that these substances behave exactly as do animate beings under the same conditions. That is to say, a metal emitting the rays in a normal state ceases to emit them when subject to chloroform vapors. In short, anesthetics apparently will send to sleep these metals as well as flowers and animals.

The action of the Wisconsin Outing Club suggests to others the means of visiting the St. Louis fair without spending much money for the trip. This club brings its members from any part of Wisconsin, gives them a week at the exposition and returns them to their homes, every item of expense, including board and lodging, paid for $30. Steamer rides on the Mississippi and many side trips are included, baggage is transferred and even street car fares

are paid. This clearly suggests what those of other States can and doubtless will do.

The Advantages of the Pole Lathe.

Pole lathes are very largely used at the present time in Buckinghamshire, round the neighborhood of High Wycombe, the center of the chairmaking industry, and although about the most primitive form of lathe existing, almost the whole of the legs and spars of chairs are turned upon them, the main reasons being their cheapness and portability, coupled with the fact that there is practically nothing to get out of order, a very important item, as they are erected in what are technically known as "shops," a very rough kind of hut, which the chair-turner puts up in the beechwoods which largely cover the Chiltern Hills; and they are thus exposed to conditions which would practically ruin a good lathe. The trees are cut down, sawn into the required length, split to a convenient size, and then the turner puts them into the lathe, and turns them with surprising rapidity, so that the "shop" is soon surrounded with little stacks of chair legs, spars and piles of turnings, this latter being the reason why the turning is done in the woods, as no waste has to be carried away, the chips being scattered in the woods—a saving of almost 50 per cent. in cartage. One advantage of the pole lathe is that both centers are "dead"; consequently, if the turner is a capable man, the work is bound to be true.—*C. T. Sutton, in The Engineer.*

A thrilling flywheel accident occurred June 30 in a factory at Milburn, N. J. The mill was running at night, the main belt broke, the engine ran away, the flywheel burst while the engineer was closing the throttle and he was killed and great damage was done. The steam pipe was broken and the superintendent of the mill, before he could shut off the steam at the boiler, was severely scalded and otherwise injured.

Technical Publications.

"Les Applications des Aciers au Nickel, avec un Appendice sur la Théorie des Aciers au Nickel." By Ch. Ed. Guillaume. Pp. 215, 6x9 inches. Ills., 25. Paris: Librairie Gauthier-Villars, Quai des Grands-Augustins, 55. Price, 3½ francs.

The name of M. Guillaume is already famous in connection with that recently discovered property of nickel-steel alloys by which they can be produced either non-expansible or with a definite degree of expansibility. The elements of the subject have previously been pretty well exploited in print by M. Guillaume, and it may be remembered that a year or so ago we published an interesting communication from him in these columns. The present treatise discusses at length the applications of nickel-steel alloys in instruments of surveying, chronometry, etc., embodying the results of more recent practical experiences, and it contains a more mature discussion of the puzzling theory of "Invar," a theory which seems to have undergone some modification in respect to the question of chemical or mechanical combination of the metals in the alloy. It is well to note that the subject embraces not only an anomaly of expansibility but an anomaly of elasticity. For those who may be interested in this practical, as well as curious, branch of physics—and we should suppose they must be not a few—this authoritative book is evidently one that will meet their requirements, so far as the subjects it treats are concerned.

Personal.

Cooper Hewitt, who is perfecting his new light, is to have an electrical laboratory in the tower of Madison Square Garden, 210 feet above the ground.

Gardner S. Williams, M. Am. Soc. C. E. and professor of Experimental Hydraulics in charge of the Hydraulic Laboratory of Cornell University, has been appointed to the Chair in Engineering at the University of Michigan, made vacant by the death, last fall, of Prof. Chas. E. Greene. Professor Williams is a native of Saginaw, Mich., and graduated from the University of Michigan in the civil engineering course in 1889. During portions of 1887, 1888 and 1889 he was engaged upon water works construction at Bismarck, Dakota, Greenville and Owosso, Mich., and in 1890 became engineer for the Russel Wheel & Foundry Company, of Detroit. In 1893 he was appointed civil engineer to the Board of Water Commissioners of Detroit and carried on the now famous experiments upon the flow of water in pipes for which, with his collaborators, he received the Norman Medal of the American Society of Civil Engineers for 1901. In 1898 he accepted the position with Cornell University which he has held since and in which he has been connected with many important hydraulic investigations. He has also carried on an extensive consulting practise. Last fall he was appointed by President Roosevelt one of the representatives of the United States upon the International Commission on Lake Levels and Navigation. Professor Williams expects to remain at Ithaca till the first of September, carrying on experimental work with advanced students.

Obituary.

I. A. Finch, president of the Finch Manufacturing Company, foundrymen and machinists, Scranton, Pa., died in New York city, June 28, sixty-seven years old.

Herman Frederick Witte, general superintendent of the Otis Elevator Works, died at Yonkers June 26, forty-four years old. He was formerly superintendent of the Crane Elevator Works and upon the consolidation of the companies he was made general superintendent.

Joseph Hinerth, president of the Highgate Foundry Company, Highgate, Vt., died June 11, fifty-eight years old. Mr. Hinerth learned the molder's trade and worked in several cities in the United States and in Canada. In 1882, with a partner, he bought the foundry at Highgate, later becoming sole proprietor and organizing the company of which he remained the principal owner.

James Paton, general manager of the National Safe & Lock Company, Cleveland, Ohio, died June 27, seventy-two years old. He was born in Glasgow, came to this country in the early fifties, working as a journeyman for some years and then being promoted to positions of responsibility. He had been superintendent of the plate department of the Cleveland Rolling Mill Company and also for a time was superintendent of the Union Iron Works. The Emma blast furnace was built under his supervision, and he was one of the organizers of the Crescent Tin Plate Company.

Theodore Winthrop Phillips, for a third of a century prominent in the steam engine industry of Rhode Island, died at Providence, R. I., June 26, sixty-eight years old. He became a bookkeeper with the Providence Steam Engine Company in 1856 and in 1872 he was made secretary and put in charge of the works. He was very successful in securing orders for the Greene engine, one of the rivals of the Corliss. He acquired an excellent knowledge of the principles of steam engineering and was quick to adopt improvements, especially when the development of the trolley system called for direct-connected machines of large power with compound steam drive. Mr. Phillips continued in charge of the Providence Steam Engine Company until it was reorganized as the Providence Engineering Works for the manufacture of the Rice & Sargent engine. About six years ago he was appointed Eastern representative of Filer & Stowell, of Milwaukee.

Manufacturers.

Fire has destroyed an ice plant of the Tucson (Ariz.) Ice & Cold Storage Company.

A new sulphite mill is to be erected by the Carthage (N. Y.) Tissue Paper Company.

J. B. Atchinson's planing mills and new sawmill, Cornwall, Ont., have been burned.

J. W. Lathrop, Mystic, Conn., manufacturer of gasoline engines, expects to enlarge his plant.

It is said that J. M. Denning, Cedar Rapids, Ia., will erect a wire nail mill and fence factory.

The McDowell Manufacturing Company, wall ties, Pittsburg, Pa., has bought a factory site in Millvale.

Work has begun on a large factory at Carteret, N. J., for the Benjamin Moore Paint Company, of New York.

The Beals & Torrey Shoe Company, of Milwaukee, Wis., is about starting to build a shoe factory in Watertown.

The Buffalo (N. Y.) Veneer Company will erect at once a building 100x154 feet, and later a building 50x100 feet.

B. H. Harris, of Medford, Ore., who has a large timber tract in the vicinity of Big Butte Falls, is locating a millsite.

The United States Foundry & Sales Company, South Norwalk, Conn., has received a permit to erect an addition to its plant.

Work has been started on the foundation of an addition to the J. R. Torrey Razor Company's establishment, Worcester, Mass.

It is understood that improvements will be made to the plant of North Bros. Manufacturing Company, foundry, etc., Philadelphia.

Fire at Chicago has damaged a large building occupied by the Library Bureau (Inc.), library and office supplies, including furniture.

The New England Enameling Company, Middletown, Conn., has started to erect three new buildings for galvanizing and other purposes.

F. H. Clergue, A. B. Wolvin and W. F. Fitch are prime movers in a company which will soon erect a great coke plant at Sault Ste. Marie, Mich.

A building at 168 Centre street, New York, occupied by Joseph S. Barker, manufacturer of gas fixtures and plumbing supplies, has been damaged by fire.

The Hoffman-Corr Manufacturing Company, rope, twine, etc., Philadelphia and elsewhere, is thinking of locating a plant in Camden, N. J., for cotton spinning.

The contract has been given for a 30x120-foot addition to the plant of the Berbecker & Rowland Manufacturing Company, Waterville, Conn., brass specialties, etc.

George F. Motter & Sons, manufacturers of boilers, etc., York, Pa., are building a new shop to be used for erecting machinery. It will be equipped with the latest appliances.

The Sternberg Manufacturing Company, maker of cigar molds, Davenport, Ia., expects to build a new plant, including a 130x40-foot wood-work shop, 70x40-foot machine shop and 36x45-foot boiler-house.

The contract for a new building of the Hoefer Manufacturing Company, manufacturer upright drills, etc., Freeport, Ill., has been awarded. It will be 60x120 feet, three stories, with an "L" 60x42 feet.

With the Regent Shoe Company, Omaha, Neb., have been merged the Williams Shoe Company, of that place, and another concern. It is expected that manufacturing operations will be enlarged in consequence.

The Van Buren, Heck & Marvin Company, Findlay, O., is contemplating the erection of another building at its new plant. This addition will be used for a foundry in which the castings for the traction ditchers will be made.

The Bukolt Manufacturing Company, maker of washing machines, Stevens Point, Wis., is erecting a new factory building, three stories, 40x70 feet, adjoining the old one, for the manufacture of the company's self-rocking cradle.

President Kennington, of the Jackson (Tenn.) Board of Trade and Cotton Exchange, is negotiating with Philadelphia capitalists who plan the erection of a plant there for working up linters from the cotton oil mills.

The plant at Martin's Ferry, O., of the Riverside Bridge Company, Wheeling, W. Va., which was destroyed by fire last winter, is about to be rebuilt. The new building will contain the main office, machine shop, templet makers' shop and the electric power rooms.

Martin Hardsocg, Ottumwa, Ia., has invented the Little Diamond Drill and a pneumatic hammer to be used with it, and it is likely that a factory will be built there for their manufacture, if questions of patentability and originality turn out satisfactorily. We judge that this is a mining drill.

It is reported from Monterey, Mex., that a plant to manufacture cement will be erected at San Nicholas Hidalgo, in the same State. A company with a capital of $280,000 gold is being organized. W. Graham, of Mexico City, is to be president, and A. G. Cardenas, of Monterey, is also interested. Work on the plant is expected to begin October 1.

T. E. McDermott, of Pittsburg, has secured an interest in the Riverside Manufacturing & Supply Company, Connellsville, Pa., and the stock of that concern will be increased from $10,000 to $25,000. The name of the concern will be changed to the Riverside Metal Refining Company. Its work will include the refining of linotype and stereotype metals.

The Seamless Rolled Pipe Company has purchased a tract of land on the Delaware River front, between Central avenue and Flower street, Chester, Pa., on which it is intended to erect a plant and employ several hundred men. The officers of the new company are: President, E. C. Kent, of Philadelphia; secretary, Edward Justinson; treasurer, John Roberts, of Philadelphia.

The plant of the Losch Engine Company has been moved to Reading, Pa., from Schuylkill Haven, and is occupying a new corrugated iron building at 104 Court street, which was fitted up as a machine shop. The firm has been engaged in the manufacture of kerosene engines for several years and will employ twenty-five hands. J. S. Losch is the head of the concern, and the engines turned out are made largely on his own patents.

Plans have been completed by business men of Hazelwood, Pittsburg, Pa., for the formation of the Hazelwood Brewing Company, with $200,000 capital, and the erection of a brewery with a yearly capacity of 50,000 barrels. The company will be formed by increasing the capital of the United Ice & Supply Company from $90,000 to $200,000. The ground and present refrigerating plant of this company will be utilized by the new brewery. Edward O'Donnell, president of the United Ice & Supply Company, will be president of the brewing company.

A Mexico City paper states that Charles L. Seeger, Primera de Humboldt No. 12, that city, representative of the Whitney Iron Works Company, and John H. Murphy, of New Orleans, have contracted with the Motzorongo Company for the installation of a complete sugar machinery plant for the company's hacienda, of Motzorongo, near Cordova, State of Veracruz. The Motzorongo Company is incorporated under the laws of Arizona, and has a capital of $1,250,000, United States gold. Its headquarters are at 218 Reaper Block, Chicago, Ill.

New Catalogs.

Abner Doble Company, San Francisco, Cal. Catalog illustrating and describing "Tangential" water wheels. 4½x7, paper.

Great Lakes Engineering Works, Detroit, Mich. Catalog illustrating the types of vertical compound two-stage compressors made by this company. 3½x6, pp. 13, paper.

The Emerson Steam Pump Company, Washington, D. C. Emerson double cylinder steam pumps and Emerson quick-cleaning strainers and foot valves. Illustrated. 6x9, pp. 23, paper.

Atlas Hanger Manufacturing Company, 1841 Park avenue, New York. Booklet descriptive of the Atlas hanger, for conduit pipe, flexible conduit, wire cables and pipes of all kinds.

Lucas Machine Tool Company, Cleveland, Ohio. "The Man, the Dog and the Barn Door," booklet giving a little talk on the "Precision" boring, drilling and milling machine made by this company.

The Ingersoll-Sergeant Drill Company, New York. Pamphlet describing and illustrating in detail the design and construction of "Haeseler" pneumatic chipping and riveting hammers. 3½x8¼, pp. 10, paper.

The Link Belt Engineering Company, Philadelphia, Pa. Catalog No. 39, describing the design, construction and application of the Renold silent chain. Illustrated by half-tone cuts and drawings. 4x7½, pp. 34, paper.

A. W. Harris Oil Company, Providence, R. I. "An Oily Tale" is the title of a recent publication of this company, which, by amusing illustrations and interesting text, tells of the merits of Harris oils for the engine-room. 6x9, pp. 14, paper.

Link-Belt Engineering Company, Philadelphia, Pa. Booklet No. 38, "Retail Coal Pockets," dealing with the advantages of using coal-handling machinery. A number of illustrations of Link-Belt systems are shown. 6x9, pp. 32, paper.

Keystone Electric Company, Erie, Pa. Partial list of installations of Keystone power and lighting machinery. 4½x8, pp. 20, paper. Bulletin No. 4001 of switches, switchboards, panel boards and cabinets. Illustrated. 8x10½, pp.7.

Federal Manufacturing Company, Cleveland, Ohio. "Will It Pay You to Change to Electric Wagons?" is the title of a folder written for the purpose of enabling those interested to ascertain if a change from horse-drawn to electric wagons would pay them.

Marshall & Huschart Machinery Company, Chicago, Ill. This firm has sent us an attractive and unusually serviceable loose-leaf binder, with the name AMERICAN MACHINIST inscribed in gilt, containing a collection of descriptions and illustrations of the varied line of machine tools this company handles. 9x12.

Brown Hoisting Machinery Co., New York, N. Y. We have received from this company a series of attractive cards in colors, each illustrating some application of the company's cranes and hoists. They are gotten up specially for the St. Louis exposition, and will be given away to all who apply for them at the company's exhibit in the Machinery Building.

Baird Machinery Company, Pittsburg, Pa. "Small Tool Catalog." This catalog contains some 650 pages and covers a full line of small tools for the machine shop and toolroom, machinists' hardware, etc. It is profusely illustrated throughout, and prices are given of the various articles shown. The book is fully indexed and is bound in cloth, with stiff board covers. 6x9.

Ingersoll-Sergeant Drill Company, New York. Air compressors. While this publication contains really only the "advance sheets" of a larger and more complete catalog, No. 36, it is a complete catalog in itself, and shows the different sizes and types of air compressors made by this company. Illustrations of a number of installations are given, including one of the largest air compressors in the world, which was installed by this company at the works of the Homestake Mining Company, Lead, S. D. An illustration is also shown of the company's large new works at Phillipsburg, N. J. 7x10, pp. 71, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Shop agents wanted for my rules with handle. W. E. Severance, Revere, Mass.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Special machinery to order. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Second-hand vertical boring mill, 60 or 72 in.; must be in good condition. Ft. Scott Mfg. Co., Ft. Scott, Kan.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

A director of methods for increasing machine shop output solicits engagements; vast experience; excellent record. Box 104, A. M.

Addressing machines without type; high speed; run by motor or foot power; write for the picture book. B. F. Joline & Co., 123 Liberty st., New York.

"Railroad Pointers"—A handy vest-pocket booklet about tractive power, grades, curves, types of locomotives, cars, air brakes, etc., etc.; 10c. coin or stamps. The Derry-Collard Co., 257 Broadway, New York.

Wanted—To build, by day labor or contract, medium weight or heavy machines or parts for machines; ideas developed and machines built; our plant is new and up to date; 36 years' experience. Address M., care AMERICAN MACHINIST.

Just Out—A new and complete course of instruction, illustrated by blueprint shop drawings, on gasoline engines, motor carriages, boat machinery and aerial motors; with free consultation, sketching and expert advice on your own problems; send for prospectus. S. N. Howell, Mechanical Engineer, Zanesville, Ohio.

New Turbine.—Dr. F. Stolze, lecturer at the Berlin Royal University (add. 188 Uhland str., Charlottenberg, Berlin), wishes to find private capitalists or company who would interest themselves in his patented new hot air turbine; entirely new system which will exceed anything already known in the way of economy, power and smallness of its dimension.

For Sale.

For Sale—Belted air compressor, 7 x 7, 250 lbs. pressure; equipped with pressure relief. Box 107, AMERICAN MACHINIST.

For Sale—An old-established pattern shop; excellent reputation; centrally located in New York city; equipped with up-to-date woodworking machinery; splendid opportunity for energetic party; selling because another line requires more attention. Address "Patterns," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

INDIANA.

Position as superintendent or general foreman, by practical young mechanic; large experience in handling work and men; good executive and shop organizer; a hustler all the time; understands designing of special tools and jigs. Box 111, AMER. MACHINIST.

NEW YORK.

Mechanical draftsman, with extensive experience, desires a position. Box 96, AM. M.

Draftsman, designer, with shop experience, seeks position. Box 108, AMER. MACHINIST.

Draftsman wishes position; 8 years' experience; thoroughly familiar with automobile construction. Box 102, AMER. MACH.

Machine shop foreman wants position; refers to Cameron Steam Pump Works, East 23rd st., New York. Address Box 110, A. M.

Situation wanted as foreman or erecting engineer; experienced in high-speed engines, gas and automobile engines. Address S., care AMERICAN MACHINIST.

Toolmaker, with many years' experience in designing and making of screw machine tools, wants to make a change. William Tottrup, 227 Havemeyer st., Brooklyn, N. Y.

Superintendent, familiar with the economical production of metal articles, is open for position; thorough mechanic and draftsman; good executive. Address Box 112, AM. M.

As superintendent or manager of large concern; experienced on engine, electrical, machine tools; automatic machinery; correspondence treated confidential. Box 105, AM. M.

Manager.—A man with 14 years' experience in manufacturing, the last 5 as works engineer and superintendent, will consider change; in prime of life; clean personality; good business man and executive; salary, three thousand or better. Address "Director," care AMERICAN MACHINIST.

OHIO.

A successful man of extensive practical experience in manufacturing is prepared to accept the management of a large or medium factory, consisting of foundry, machine shop, boiler, blacksmith or wood-working departments, with a percentage of the profits as remuneration; an excellent opportunity for parties in possession of plants from which they are not receiving satisfactory returns, through lack of modern methods or fear of labor troubles. Address Box 106, AM. M.

RHODE ISLAND.

Wanted—Position on B. & S. automatic screw machines; capable of taking charge; A1 reference. Address V. H. A., 180 Mathewson st., Providence R. I., care N. S. Bishop.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—First-class operator for Jones & Lamson lathe. Apply Ross Rifle Co., Quebec, Canada.

Wanted—A competent foreman to take charge of the erection and installation of interlocking plants; give experience and reference. Box 88, AMERICAN MACHINIST.

FLORIDA.

Wanted—A thorough job shop machinist; one competent to act as foreman when necessary. Address Florida Machine Works, Jacksonville, Fla.

ILLINOIS.

Wanted—Good salesmen; must be mechanical engineers; good proposition to first-class men. Address Hawley Down Draft Furnace Co., Chicago.

MASSACHUSETTS.

Wanted—Foreman for machine shop and repairs in large manufacturing plant; requires a first-class machinist; experienced as foreman. Address "Mass," care AM. MACH.

NEW YORK.

Wanted—Competent machinery designer. Address, stating experience, Niagara Machine & Tool Works, Buffalo, N. Y.

Designing draftsman on steam pump work; location, Greater New York; state experience, references, age, nationality, etc. Address Box 109, AMERICAN MACHINIST.

Wanted—First-class turret lathe hands; must be strictly sober and used to accurate work; give age, experience and references. Box 103, AMERICAN MACHINIST.

OHIO.

Wanted—Draftsman, technical graduate, experienced in making tool design and in up-to-date drawing room and shop practice; good position; references required. Box 9, AMERICAN MACHINIST.

Wanted (for master mechanic)—A first-class man, between 35 and 45 years of age, to take charge of the mechanical departments of our factory; one having some technical education preferred; applicant must have a thorough knowledge of methods used in manufacturing small machines requiring duplication of parts, enough executive ability to properly handle men and foremen of departments under his supervision, and be capable of bringing tools, jigs, fixtures and machinery to the highest point of efficiency; a first-class position for a man of energy with ability to produce results; in applying, give age, references, experience in full and salary desired. Toledo Computing Scale Co., Toledo, Ohio.

PENNSYLVANIA.

The Monotype Company maintains a school to train young men to meet the constantly increasing demand for operators of its type casting and composing machine. These operators have done so well that it receives more applications for places than can be filled. In making selections these qualifications carry most weight: common sense, type foundry experience, printing office experience, automatic machinery experience. Full particulars will be furnished to inquirers who furnish the same information about themselves. The Lanston Monotype Machine Co., 1231 Callowhill st., Philadelphia, Pa.

WEST OF MISSISSIPPI.

Three first-class machinists; general hands; one must thoroughly understand operation of roll grinding and corrugating machines; steady work; "open shop." Address Box 488, AMERICAN MACHINIST.

WISCONSIN.

Machine foreman wanted; none but first class need apply; work heavy and light; good salary to right man. Address "High Speed," care AMERICAN MACHINIST.

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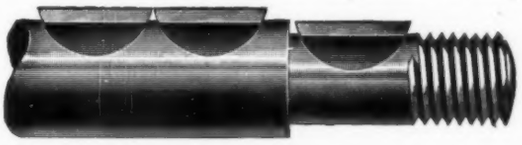
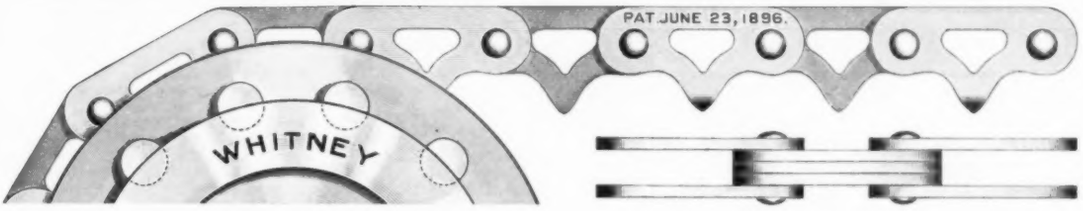


No. 16 Cutter Full Size.

THE WHITNEY MFG. CO.

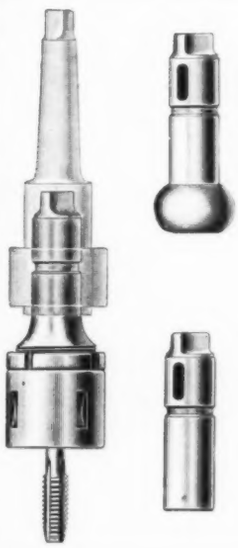


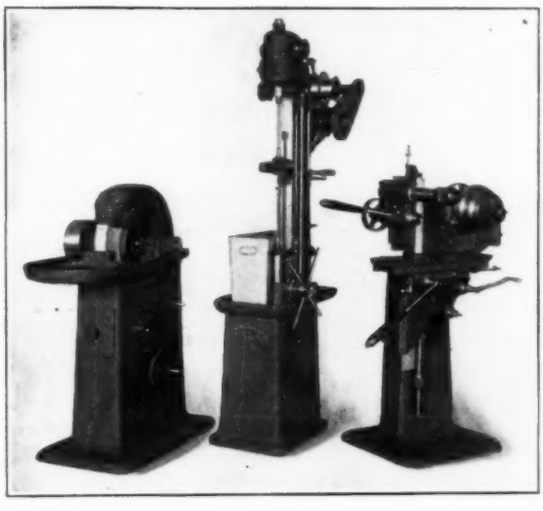
CHAIN DEPARTMENT.

Roller Chains—Block Chains, "Wizard" Chains.

New Construction, Cotter Detachable, Patent Pending.

THE WHITNEY MFG. CO.





MACHINE DEPARTMENT.

Hand (feed) Milling Machines,

20-inch Water Tool Grinders,

Presto Drill Chucks, Collets and Friction Tapping Devices,

Vertical Automatic Drilling Machines (for long holes).

THE WHITNEY MFG. CO.

FOREIGN AGENTS.

C. W. Burton, Griffiths & Co., Great Britain.

Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia.

Fenwick Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal.

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Norton Emery Wheel Co., Worcester, Mass.
Vitrified Wheel Co., Westfield, Mass.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Ball Bearings

See Roller Bearings.

Balls, Steel

Federal Mfg. Co., Cleveland, O.

Band Saws, Metal

Niles-Bement-Pond Co., New York.
Oliver Mchy. Co., Grand Rapids, Mich.
Thompson, Son & Co., Henry G., New Haven, Conn.

Barrels, Steel

Kilbourne & Jacobs Mfg. Co., Columbus, O.

Bars, Boring

Beaman & Smith Co., Provi., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

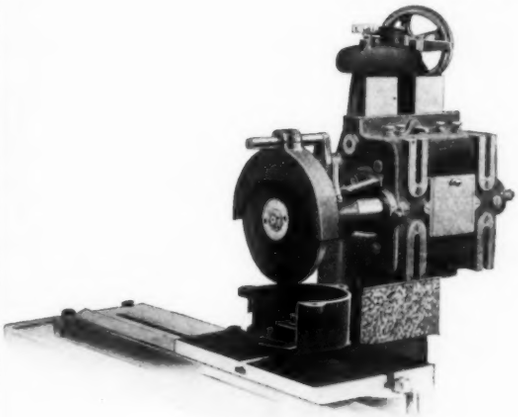
BROWN & SHARPE MFG. CO.,

Providence, R. I., U.S.A.

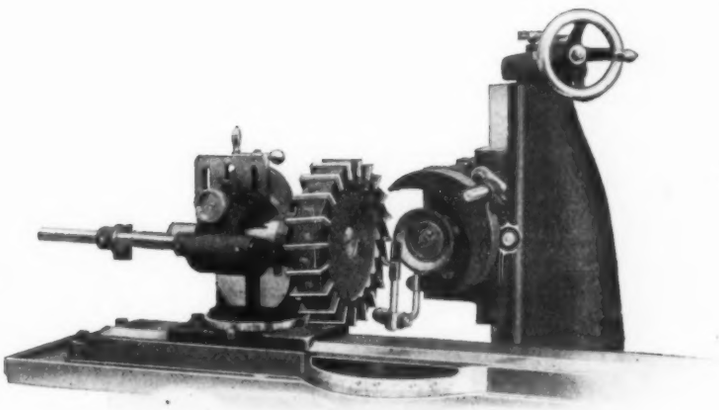
A Few Suggestive Examples

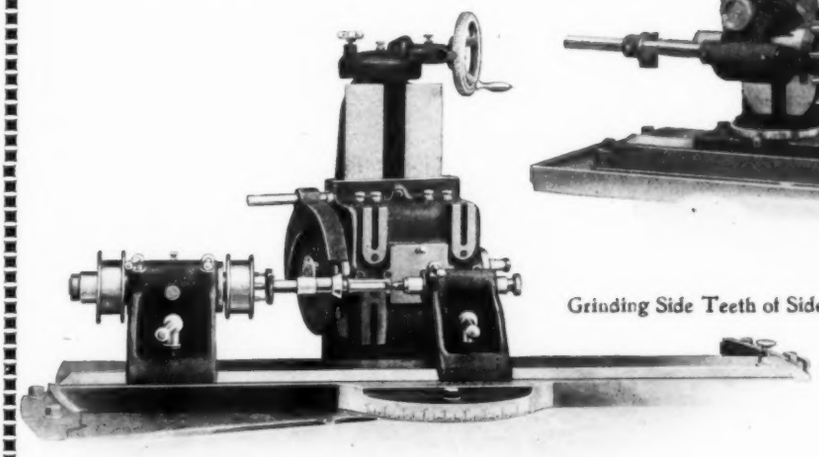
of work that may be performed on the

No. 13 UNIVERSAL AND TOOL GRINDING MACHINE



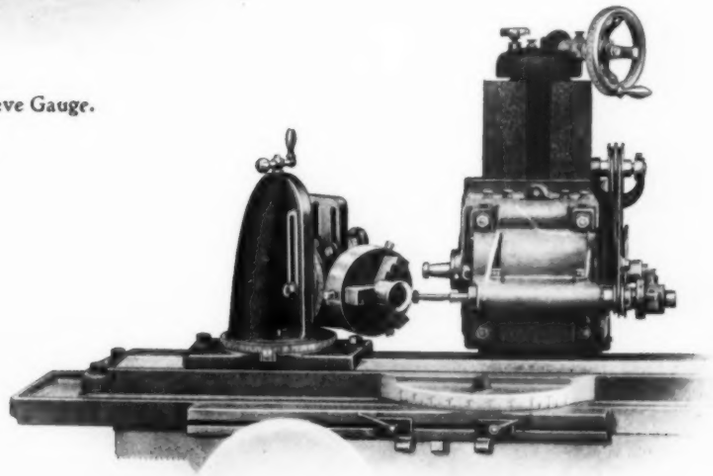
Surface Grinding a Cast Iron Guard.
(Using Surface Grinding Attachment.)





Grinding Side Teeth of Side or Face Milling Cutter with Inserted Teeth.

Grinding Taper on Chuck Sleeve Gauge.



Grinding Convex Cutter, Coarse Teeth.
(Using Circular Grinding Attachment.)

Grinding Inside Conical Surface.
(Using Internal Grinding Attachment.)

Our experience is at your service and we may be able to help you in your Tool Room Work.

Catalogue and descriptive circular mailed to any address upon application.

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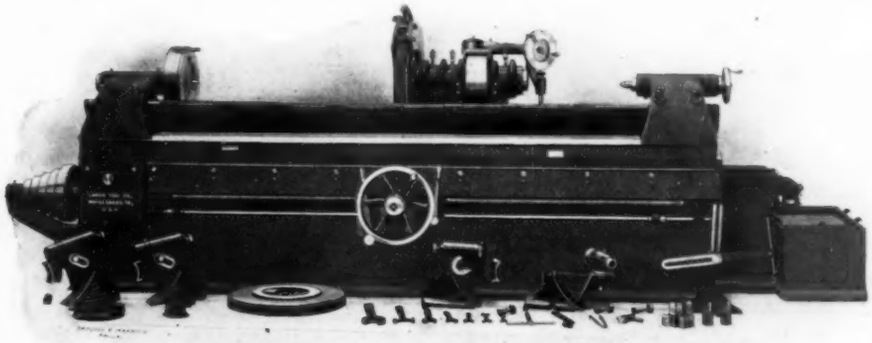

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The Rapid Grinders.

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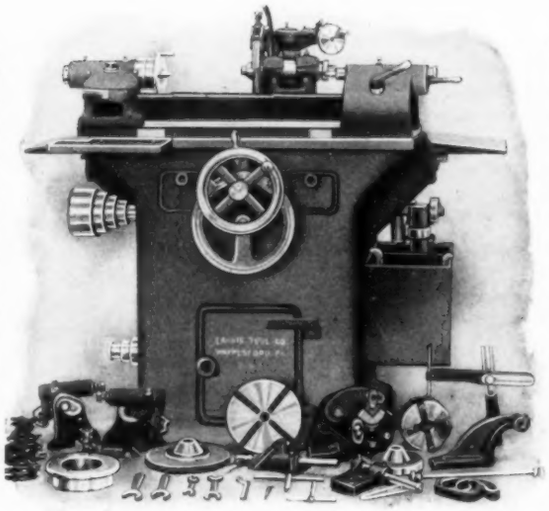

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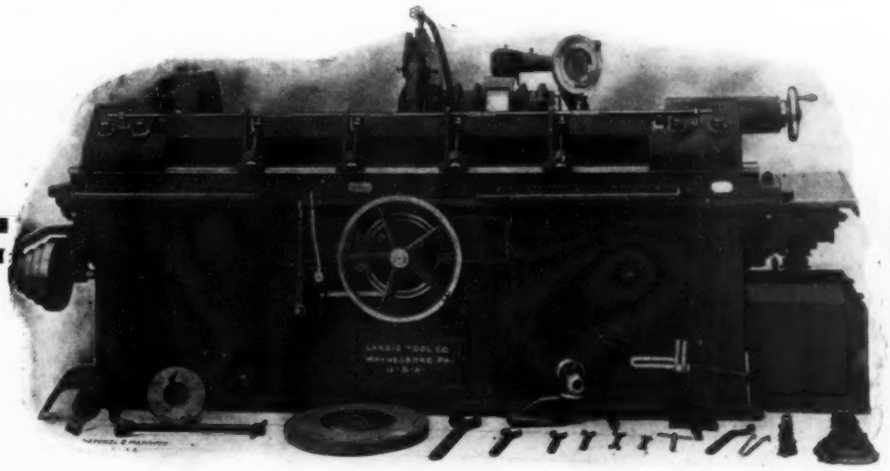
The Versatile Grinders.



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Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Stevens, F. B., Detroit, Mich.

Furnaces, Coal and Oil
Obermayer Co., S., Cincinnati, O.
Rockwell Engineering Co., Jersey City, N. J.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Rockwell Engineering Co., Jersey City, N. J.
Westmacott Co., J. M., Providence, R. I.

A Few Tools From Bullard's.

EDITORIAL CORRESPONDENCE.

The grinders shown in Figs. 1 and 2 are a pair of special machines seen during a recent visit to the shops of the Bullard Machine Tool Company at Bridgeport, Conn. The first is for grinding reamers, the second for sharpening counterbores and certain other end-cutting tools, and both were designed by and built under the supervision of Henry Mussler, foreman of the tool department. Both grinders are exceedingly simple in construction, each caring for just the one line of work; the sole object in view in designing them being to construct two inexpensive bench machines which should always be set up and ready for grinding the two classes of tools, of which there are a considerable number to be handled daily by the toolroom.

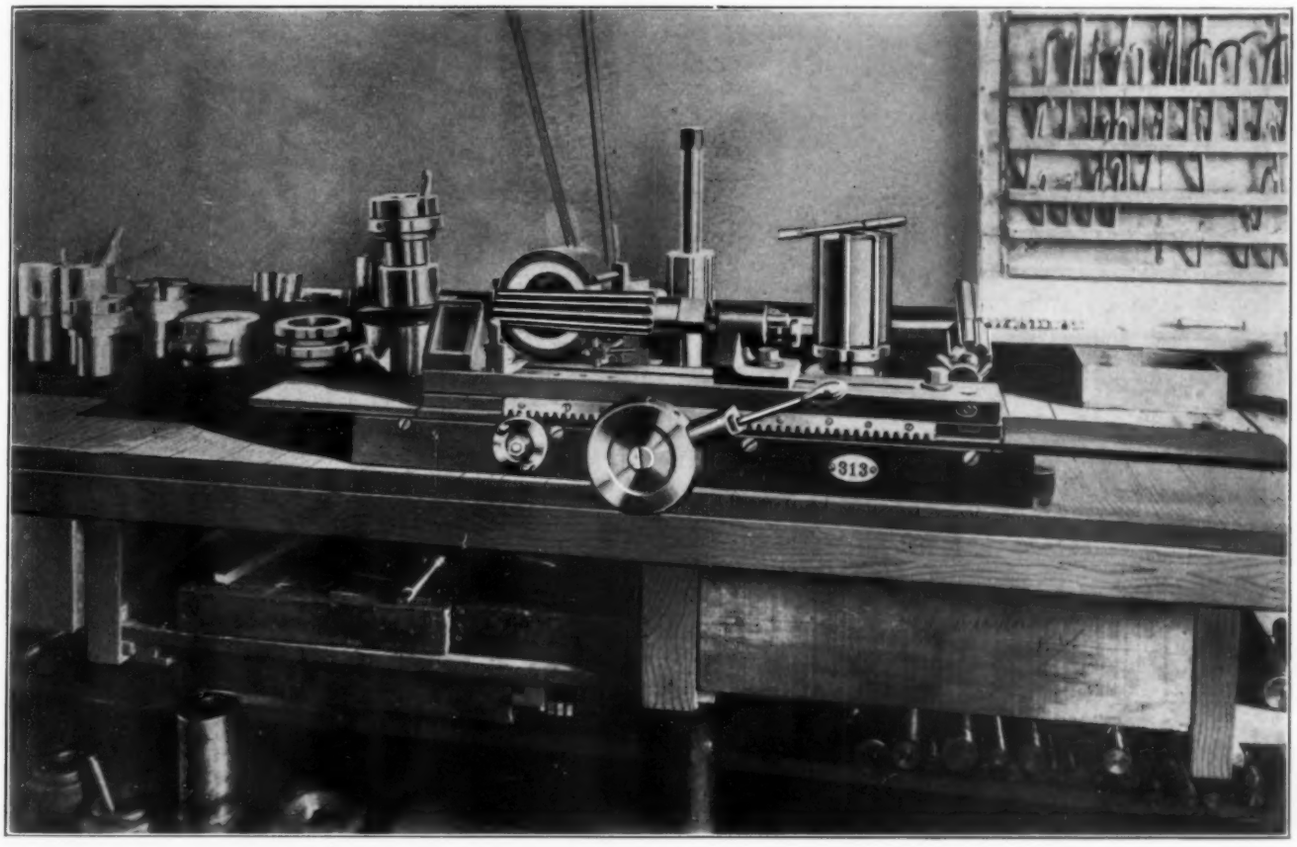

FIG. 1. A SPECIAL REAMER GRINDER.

The reamer grinder takes 20 inches between centers, and handles either straight or taper reamers of any diameter up to 6 inches. The wheel spindle is mounted at a slight angle to the table ways to permit the heel of the cup wheel to clear the reamer being ground; and the head adjustment to the work is effected by a screw and by graduations reading to thousandths.

The table is provided at the end with graduations for various tapers per foot, and by means of a screw whose handle is shown at the rear, is set to suit any required taper. It is reciprocated by the handle in front, the inner end of this handle fitting freely in holes drilled about the periphery of a disk carried at the end of the rack pinion shaft. The handle is held in place by a spring and may be easily drawn out and dropped into whichever hole in the disk will locate it most conveniently for the work in hand.

The other grinder has an oscillating movement for the work, the latter being carried by a head which is adjustably mounted on a guide secured in the way indicated to a rock shaft passing through the wheel stand base. The tool head has a spindle with a Morse No. 4 taper hole bored from the front and a twelve-hole index plate at the rear, the latter being locked by a spring pin whose head is just visible in the engraving.

The guide for the head is at a fixed angle of 10 degrees with the rock-shaft axis, this angle of clearance having been adopted as the most satisfactory one for tools of the class handled in this machine. The head is adjusted along its inclined support by means of the screw at the rear; or it may be shifted quickly by swinging up a half nut at the end of the guide, thus allowing head and adjusting screw to slide together. The knurled head screw at the side does the clamping; the grooved seat directly above receives the diamond holder when the wheel requires dressing off at the side.

The tool to be ground is set so that the cutting edge facing the wheel is in a horizontal plane when the rock shaft is in mid-position, by means of a gage which is applied to the face of the oblique guide below. The swing of the work is determined by a knurled stop screw in an arm near the center of the weighted rocker shaft. The machine is used for grinding special face mills and cutters in boring heads as large as 8 inches in diameter.

They make a good many hardened thread plugs in the Bullard toolroom, for use about the place; and for grinding the thread angles of these gages after hardening they employ an India oilstone wheel about 4 inches in diameter, which is mounted on the spindle of a Hisey-Wolf electrically driven tool-post grinder and fed by the lead screw as if it were a thread-cutting tool. The periphery of the wheel is dressed to the correct shape in the lathe by a diamond in a special holder carried in the tool-post, the compound rest being set round to an angle of 30 degrees. The wheel holds its shape long enough to finish one gage and rough out another; it is then redressed to finish the second gage and rough out the next—and so on.

A reamer which should interest lots of people is shown in Fig. 3. This was devised by the Bullard people some time ago, is used by them in all cases where vertical holes above 1¼ inches diameter are to be machine reamed, and, I should think, would be equally applicable to work chucked out horizontally as in the turret lathe.

We all appreciate the difficulties attending any effort to machine ream a hole satisfactorily with a rigidly held reamer, no matter how accurate the machine itself may be nor how true the reamer. And a good many of us have at some time or other constructed floating reamer shanks to get 'round our troubles with the "stiff-necked" variety. In the design shown, both ends are arranged to float—the reamer on its shank, and the latter in its holder. Both ends of the shank are spherically formed and then reduced toward the middle for clearance. The abutment is of course against the adjustable plug in the rear of the holder. The connection with the reamer proper is at the extreme front end, as represented; thus, while the shank is pushed ahead, the reamer is actually pulled through the hole, and owing to the practically universal connection is bound to follow the machined surface without cramping and bell-mouthing the end of the hole.

The end of the reamer is very slightly tapered for a short distance to enable it to start properly. The shank where it enters the reamer is 1-64 inch below the size of the reamer bore; the butt end of the shank measures, at the cylindrical portion, 1-32 inch less than the bore of the holder. F. A. S.

In Brazil some of the copper coins are worth considerably more for the metal in them than as money and they are being shipped away for junk.

Prevention of Accidents in Shops and Factories.

The following suggestions for the prevention of accidents have been compiled by the *Employers' Liability Commentator*. While not novel at all, they serve well as reminders, and it is well to circulate them:

All belts passing through floors or vertical shafts operating through floors should be cased in to the hight of at least 4 feet. See that belts do not have ragged places, and that the lacing or hooking is O. K.

Shafting beneath sewing-machine tables and all other shafting operating on or near floor should be covered.

Loose pulleys should be used wherever possible, so as to throw a saw, jointer, shaper or other piece of machinery out of motion when not necessarily in use, and employees should be instructed to throw out of motion such machines when leaving same even temporarily.

Shifters should be used at all times for shifting belts, and no employee should be allowed to shift a belt with his hands or stick; belts should be laced and adjusted when machinery is not in motion.

All flywheels of engines and belt wheels should be enclosed by casing in or placing substantial railing around them, either of wood or gas-pipe, the latter preferable and more substantial.

All bearings and other parts of machinery should be oiled and cleaned when not in motion, and no minor under sixteen years of age should be allowed to oil or clean machinery or to sew or assist in sewing belts.

Low-water alarm columns on boilers should be frequently tested to ascertain whether in good working order.

Set-screws in collars and couplings on line and countershafting should be covered or preferably countersunk, so that the head of the screw shall not project above the surface of the shaft. Set-keys in hubs of flywheels or other wheels should be cut off flush with end of shaft or covered with tin casing or other material fitting closely to shaft, forming a smooth surface.

All cog gearing should be completely cased in, casing to be so constructed that it can be easily removed when necessary to repair or oil; casing should be made of wood or metal.

All roll-feed machinery should be well guarded by placing strip of metal entire length of roll, strip to be placed as close as possible to roll and otherwise in such a manner as should prevent operator from getting fingers between rolls while feeding; particularly should this suggestion be observed in laundries, candy factories and bakeshops.

Fans, whether operated by steam or electricity, should be thoroughly protected by wire screens or nets.

Stairways in all large factories should be at least 4 feet wide and placed next to outer walls and be enclosed with 9-inch walls extending from ground up to and out through roof; stairway should be well lighted and arranged so as to deliver by means of a doorway at least 4 feet wide

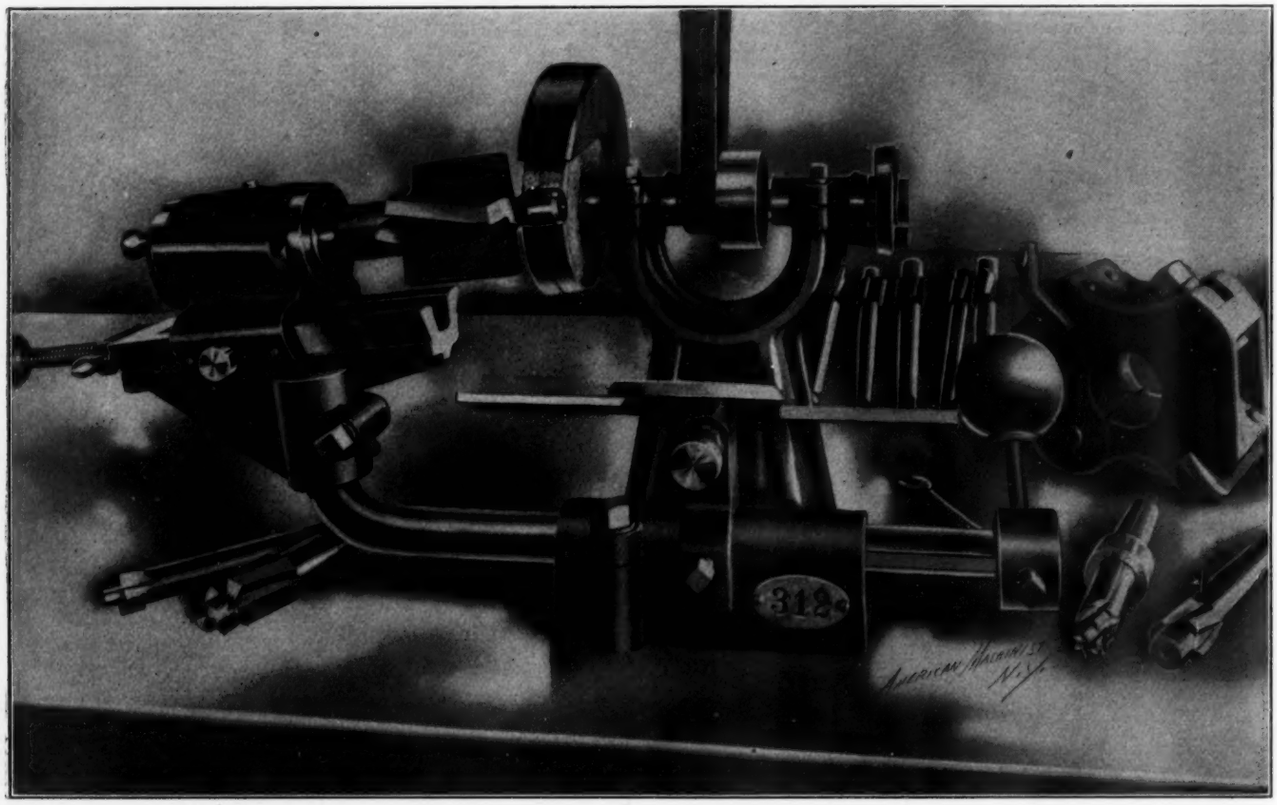

FIG. 2. A SPECIAL GRINDER FOR COUNTERBORES.

direct to the outside at ground, and all doorways leading to stairways should be hung so as to swing toward the exit or to swing both ways, and should not be permitted to be kept locked or barred during working hours; treads of stairways should not be less than 10 inches wide and risers not more than 7 inches high; all stairways should be provided with substantial handrailings solidly anchored in wall, extending from top to bottom of same.

Elevator openings on each floor should be guarded by automatic gates sufficiently high and close to prevent a person looking over or putting his head through the gate into the shaftway; persons using elevator should not, for any purpose, be permitted to wedge or prop up gates; unused sides of shafts should be cased in to a hight of 7 feet at least, either with jointed boards or substantial wire screening; cables, shives, safety catches and all elevator machinery should be examined frequently to see that it is in order; periodical tests of safety catches should be made by suspending the elevator or cage by light rope and then cutting rope to ascertain whether the safety catches will work or not, instead of waiting for an accident to prove that they do not. Employees should not be allowed to ride on a freight elevator except when accompanying freight. Danger and warning notices should be affixed to the elevator car and at the entrance to the elevator on each floor. No person under the statutory age should be permitted to operate any elevator. The employer should ascertain the legal requirement as to age of elevator attendant. Some device, bell, etc., should be used to indicate when elevator is in use.

Circular saws should be guarded when possible to do so, and employees compelled to use such guards at all times.

Persons operating grindstones and emery wheels are liable to serious injury from the bursting of the stone. The causes of such accidents are various and uncertain. Great care should be taken in storing grindstones to keep them free from dampness and protect them from the elements. A grindstone should not be stored with the stone standing upon the ground. It will absorb the moisture from the bottom, keeping one side of the stone soft and green while the balance of the stone becomes hard and seasoned. This means the expansion of the stone on the one side, and very often causes it to crack in the opposite corner of the bore from the point of absorption. Frequently this has been found to be the case with bursted grindstones, having been mounted and used, the check being undiscovered until the stone bursted. Grindstones should be stored on a raised platform at least 6 to 10 inches from the ground. The practise of using wooden angles and wedges in mounting a grindstone should not be indulged in, particularly where the stone is operated wet, from the fact that water and moisture will find their way to the wooden edges and angle pieces and cause expansion. Iron angle pieces and wedges are much better than wood. Tho all the precautions above mentioned may be taken, yet the bursting of grindstones will occur, and those operating them should be protected, in addition to the precautions suggested, against accident from flying fragments in case of the bursting of a stone.

The bursting of emery wheels also is of frequent occurrence, and care should be taken to purchase none but first-class wheels and of the highest quality. A stringent inspection should be made of each wheel to detect flaws, and the wheel should be so adjusted on spindles as to not fit too closely. The speed of an emery wheel is also an uncertain matter. One manufacture of wheel will stand a higher speed than another, and the safest rule to follow is that the wheel should be speeded only to such speed as is registered and given by the maker. The wheel should always be kept true and in balance, and the operator should use the wheel with the rest drawn up as close to it as possible, allowing sufficient clearance to relieve friction. A wedge, and the sudden stopping or checking of the wheel will, in many cases, cause it to burst. We believe we are safe in saying that a larger number of wheels have been bursted from this cause than from all other complications put together. Precautionary measures will not always prevent the bursting of grindstones and emery wheels, nor is it always possible or practicable to guard such wheels, but in many instances it can and should be done.

To absolutely prevent accident to employees on wood shapers is an impossibility, for the reason that such machinery cannot be rendered harmless or absolutely safe. The wood shaper is perhaps one among the most dangerous pieces of woodworking machinery in use, yet it can be rendered more than reasonably safe by using a shaper guard, and it should never be operated without such guard. There are many shaper guards manufactured which give satisfaction, some of them perhaps a little crude in their nature, from the fact of being a contrivance of the owner of the machine, who did not care to go to the expense of purchasing a patented device, yet serving the purpose for saving life and limb and not interfering with the utility of the shaper.

The wood jointer has caused more accidents and maimed more men for life than all other wood-working machinery combined. The causes of accident by its use often occur in an unaccountable way; sometimes due to a change in the grain in the piece of timber being worked; again by suddenly striking a knot, hurling the piece from the machine and throwing the workman's hand into the knives. Such accidents could be prevented by keeping the gage of the machine set close to the near end of the knives, only exposing a sufficient width of the knives to clear the width of the stuff being worked. This can be done and is practicable when the shaper knives are sharp and in good order, but by constantly using them in one place they soon become dull, and the gage is moved over a little farther until more of the knife is exposed, more than the width of the material being worked. Tho the most dangerous machine used in woodworking establishments, yet it is more simple and easy for which to provide a guard, rendering it reasonably more safe than other machinery of the wood-working class.

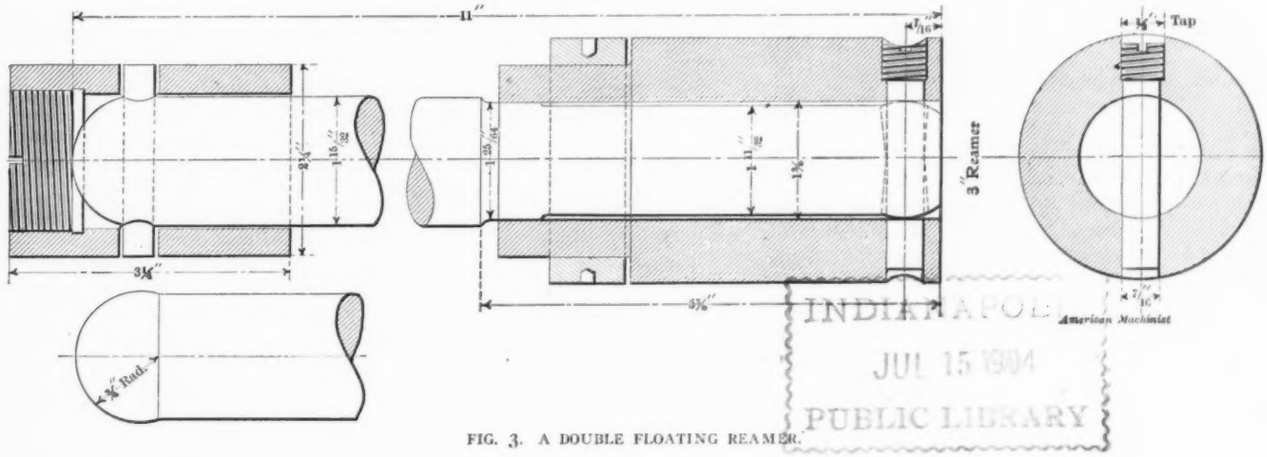

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FIG. 3. A DOUBLE FLOATING REAMER.

Experiments With a Lathe-Tool Dynamometer—I.*

The necessary reconsideration of the design of lathes for the rapid and heavy cutting rendered possible by the new steels introduced by Taylor and White, and now everywhere adopted, calls for a thorough and systematic investigation of the forces acting upon a cutting tool. If a standard area of cut can be agreed upon for the various sizes of lathes, a knowledge of the forces to be overcome when taking that cut—not only for turning the work against the tool, but also for moving the slide-rest and saddle in both the traversing and surfacing directions will enable the calculation of the stresses in, and the proportioning of, the various parts of the machine to be gone about in a rational and scientific way. The present paper records the results of over 300 serial trials, each requiring the making, recording and reducing of from 50 to 100 observations; but it is only to be looked upon as a first installment of the work required to be done in order that the action of the tools used in a machine shop may be thoroughly understood.

In Hartig's work, "Experiments on the Efficiency of Machine Tools," the law was enunciated that the cutting force varies in simple proportion to the depth of the shaving. Professor Smith, in the preface to his book, takes Hartig severely to task for proposing the above-mentioned law of variation of force with depth; but (altho the author has not had access to Hartig's work) the results of the present experiments appear to substantiate Hartig's law to, at all events, a first approximation.

Two dynamometers were used in these experiments, each capable of measuring forces up to 15 tons on the tool point when taking a cut. In the first, means were provided only for measuring the vertical force upon the point of the tool; while in the second, not only the vertically directed force, but also that tending to push the tool and saddle backwards and that tending to oppose the traversing feed were observed. The force measurer itself consisted of a hydraulic support and a Bourdon gage. The pressure was recorded by connecting the interior of the support to a steam-engine indicator, and as there was necessarily considerable leakage of the fluid past the piston, an auxiliary fluid-supply device had to be added, which not only disturbed the readings of the pressure but also made the instrument more complicated. By reading the pressure on a Bourdon gage and taking precautions in making the joints, leakage can, however, be entirely eliminated.

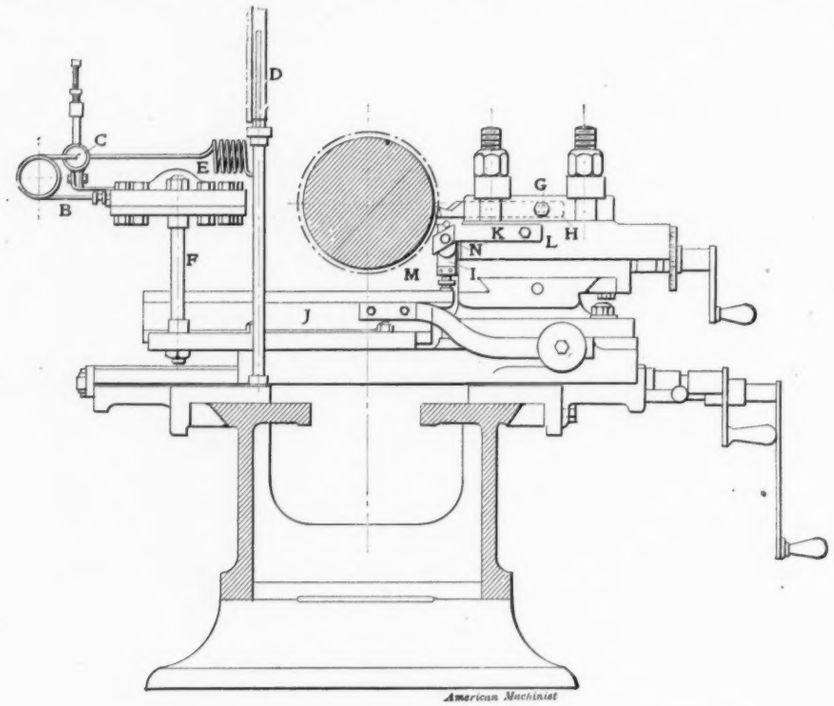

FIG. 1. END ELEVATION, WITH BED IN SECTION, OF FIRST DYNAMOMETER.

The principal hydraulic support, used for measuring the vertical force on the tool in both the first and second dynamometers, is shown in sectional elevation in Fig. 4. The compression piece A, when thrust upwards, produces pressure in the fluid, which communicates by means of the small copper pipe *B* through the make-up plug fitting *C* with the interior of the gage tube *D*.

Turning now to the other end of the dynamometer, the tool was, in the first instance, free to move only about a horizontal axis (parallel to the lathe center line). This arrangement is shown in Figs. 1, 2 and 3. The axis is formed by the points of two screws *G* passing through two massive gray-iron chocks *H* which rest upon the tool-slide. The points of the screws enter into deep center pops made on the sides of the tool before hardening. When the tool is resting freely between the two loose chocks, and the screw points are entered into the pops, the tool clamps are tightened down hard upon the former, and when the screws are then advanced up to the tool it has only one degree of freedom to move. Friction between the tool and the gray-iron side pieces, due to the vertical motion of the former, is prevented by interposing greasy plates between them; and the tool is supported near its point by the strut *I* underneath it.

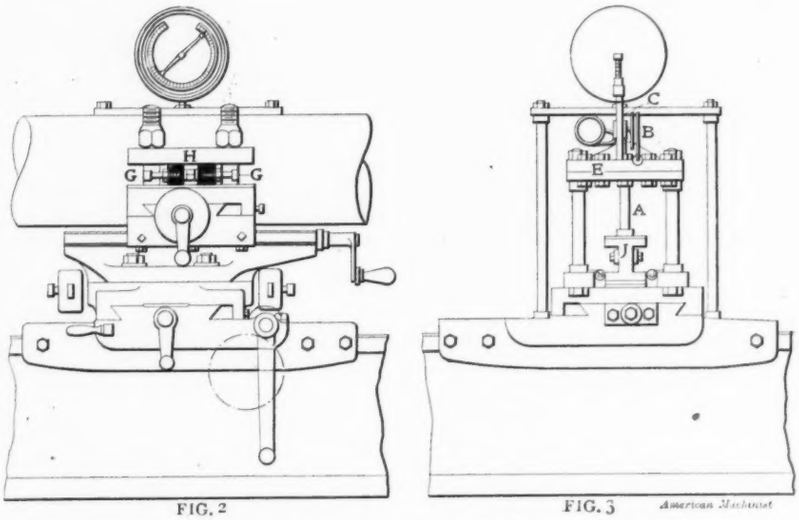

FIG. 2 FIG. 3

FRONT AND BACK OF FIRST DYNAMOMETER (NOT SAME SCALE).

This strut *I* is kept in place during the cut by the stirrup shaped piece *K*, which is hinged on the tap bolts *L*, and retains *I* by means of two pointed screws *M* which enter the centers of the tool-steel pin *N*,

*Abstract of a paper by J. T. Nicolson, presented at the Chicago joint meeting of the American Society of Mechanical Engineers and the Institution (British) of Mechanical Engineers.

connecting the double and single eye as shown. The beam is about 2 feet 4½ inches long, has a fulcrum on the under side, and another knife-edge formed upon its upper side at the opposite end for taking the diaphragm strut *A*. The fulcrum is a knife-edge 4 inches long, formed on the beam and resting on a flat steel plate upon the saddle. With this arrangement loads of over 10 tons on the point of the tool have been taken when cutting, with but little more vibration than is felt when the tool is bolted to the tool-slide in the ordinary way. The diaphragm only yields, when the fluid is air free, by the amount necessary to supply the increased volume of the gage due to the added pressure, and the spring of the tube is able to bring the arrangement back to zero when the load is removed. In order to assist this action the tool (whose point is set centrally to the work) is adjusted with a considerable droop; so that, as with a spring tool, the cutting force diminishes when the tool deflects.

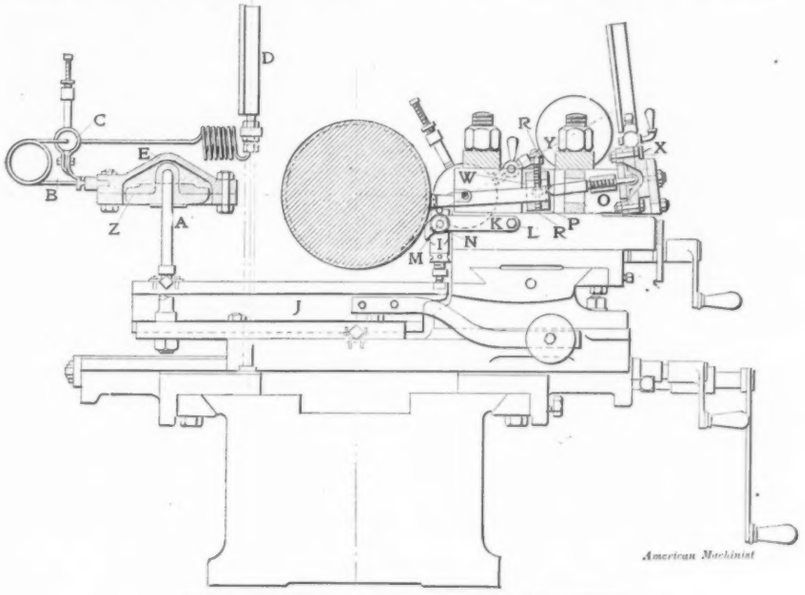

FIG. 4. SECOND OR UNIVERSAL DYNAMOMETER.

In the second form of dynamometer the same large hydraulic support *Z*, Fig. 4, cast-steel beam *J*, struts *A* and *I*, are used as in the first for measuring the downward force; but three other diaphragms are added to enable the backward and side thrusts to be measured. The side elevation of the whole instrument is shown in Fig. 4, the plan in Fig. 5, and the front and side views in Figs. 6 and 7. The loose gray-iron cheek pieces are here replaced by a casting *O*, Fig. 5, shaped to fit round the tool clamp studs, and recessed to provide for the gimbal tool-holder *P*. The object of the latter is to allow the tool freedom to move about either a horizontal axis, parallel to the lathe center line, or a vertical axis intersecting the other. Two pointed screws *Q* pass through *O* into center punch marks in the gimbal piece *P*, and two other similar screws *R* pass through the gimbal into pop marks on the top and bottom surfaces of the tool itself. As the tool point can now move horizontally (as well as vertically), the strut *I* is pointed at the bottom and rests in a recess in the cast-steel beam *J* instead of upon a knife-edge formed upon it as before. The stirrup piece *K* is now used only to retain the strut *I* in the direction of the depth of the cut; that strut being

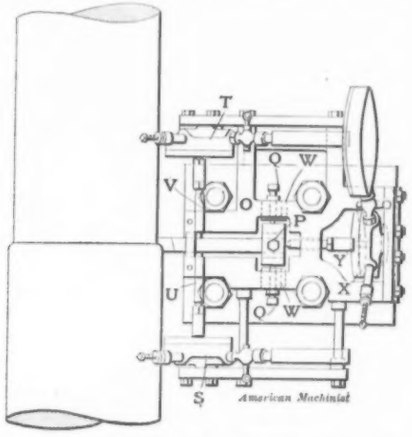

FIG. 5. PLAN OF TOOL CARRIER OF UNIVERSAL DYNAMOMETER.

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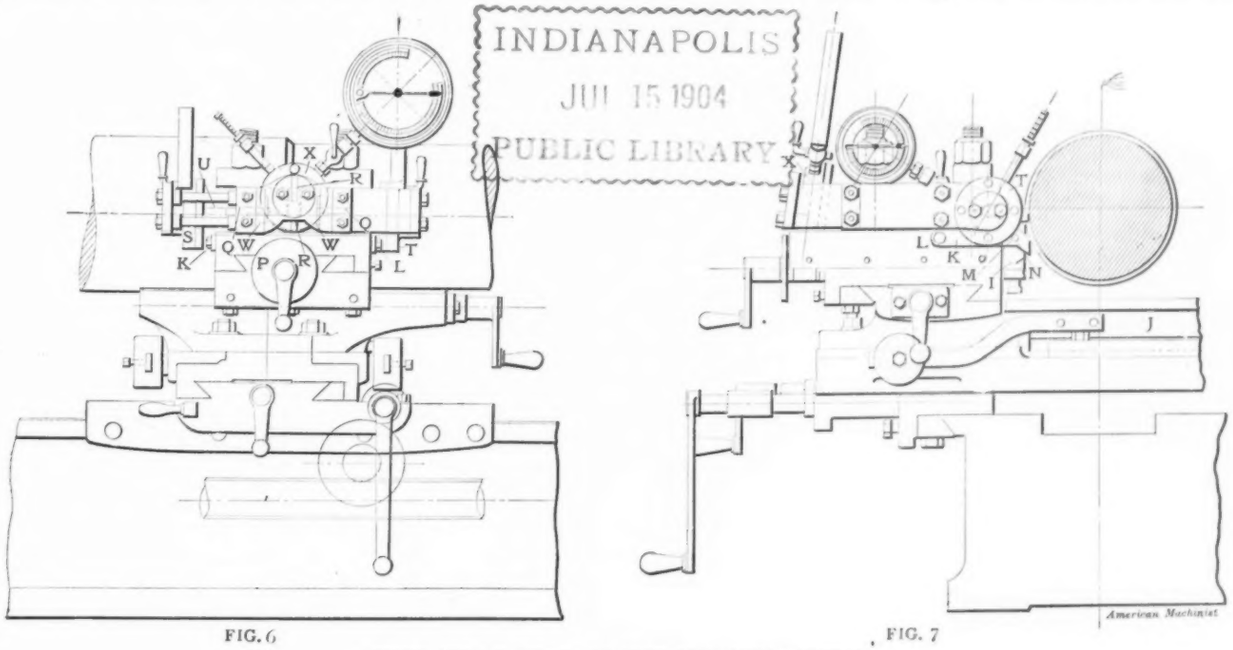

FIG. 6. FIG. 7.

FRONT AND END VIEWS OF UNIVERSAL DYNAMOMETER.

free to tilt somewhat in the direction of the traverse feed. The two hydraulic supports *S* and *T* (with struts *U* and *V* of adjustable length) are suitably placed so as to retain the tool in a fixed position, in plan, relatively to the tool slide. When

an experiment is about to be made, compression is put on both these supports S and T by screwing and lengthening struts U and V; so that the tool is firmly held sideways by two compressive forces of from 500 to 1,000 pounds each, acting upon

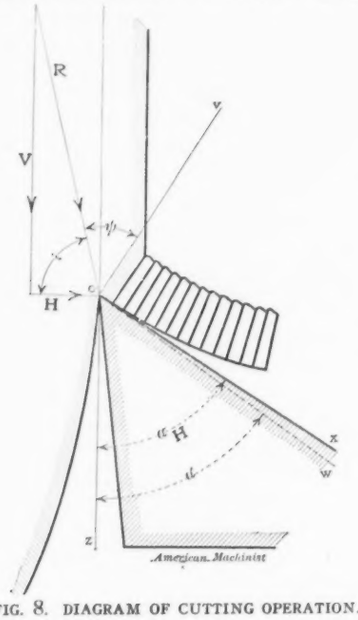

FIG. 8. DIAGRAM OF CUTTING OPERATION.

it from the supports. If, then, the tool-slide thrusts to the right when traversing it will increase the pressure on the right-hand support T, and diminish by the same amount the pressure on the left-hand support S. If it should thrust to the left, *i. e.*, draw into the cut, it will have the reverse effect.

To allow the back thrust of the tool to be measured, the pointed screws Q are not tapped through the casting O itself, but through sliding blocks W fitting in slots therein. A hydraulic support X, with its strut Y, is supplied at the back of the tool; the strut center line being inclined at the same angle as the tool, which, for

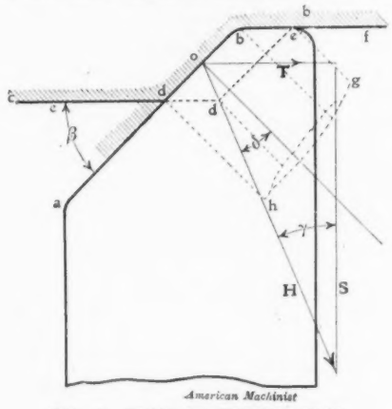

FIG. 9. PLAN OF CUTTING TOOL.

the reason above mentioned, droops somewhat towards the work.

EXPERIMENTS MADE WITH FIRST DYNAMOMETER.

The size of tool steel ordinarily used in the experiments was 1¼ inches square, altho 1½ and 2 inches square steel was sometimes employed. In projecting a series of trials upon the effect of tool angle upon cutting force, the shape of the tool point in plan required first of all to be carefully considered. Almost every variety of shape had been sent in by the steel makers in the committee's experiments, and there was no indication that any one of these was distinctly better than all the others. The round-nosed tool was the most common form, and is the easiest to forge and keep; but it has the great disadvantage, from the point of view of these experiments, that the actual cutting angle varies on a given tool with the depth of the cut. It was therefore decided to make the cutting edge horizontal and at an angle in plan of 45 degrees with the axis of the work. The top surface of the tool was a plane containing the cutting edge, and inclined at the angle called "the cutting angle" to the vertical plane, which also contained the cutting edge. The cutting edge terminated at a point ⅜ inch from the right-hand corner of the tool (in 1¼-inch-square tools) so that the average cut

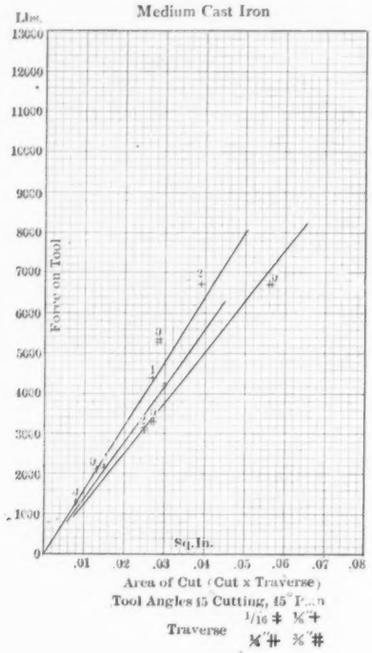

FIG. 10

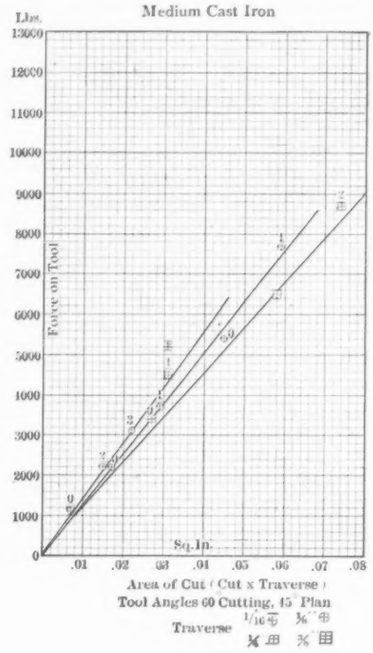

FIG. 11

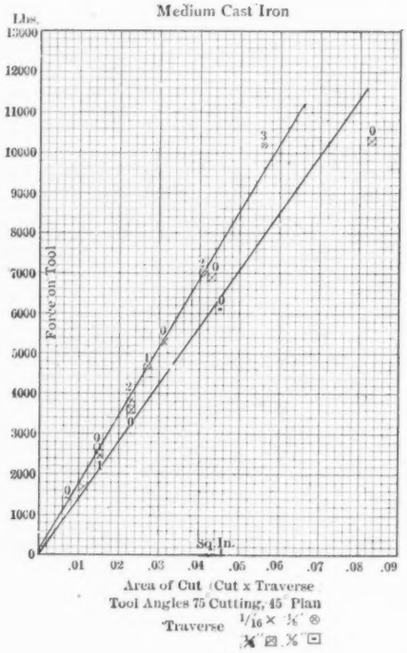

FIG. 12

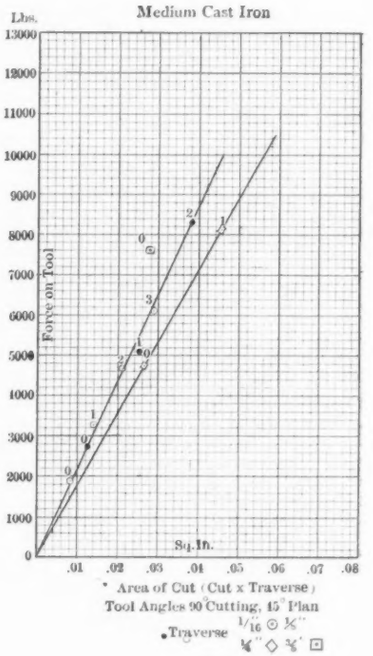

FIG. 13

DIAGRAMS OF TESTS WITH FIRST DYNAMOMETER.

taken would give a downward thrust, acting as nearly as could be arranged in the center line of the tool, so as to prevent any twisting action and undue load upon the steel center points. The nose of the tool had a clearance angle in plan of not less than 1 degree, and a small radius was ground on the corner between the two edges. The front clearance was 6 degrees, the tools being used with the cutting edge on the level of the center of the work. The form of the tool end is shown in plan and elevation in Figs. 8 and 9. (In the series of experiments made with the second dynamometer for elucidating the effect of different values of the angle (in plan) made by the cutting edge with the lathe center line, the cutting edge was still kept horizontal, whether the plan angle was 22½, 45, 67½ or 90 degrees.)

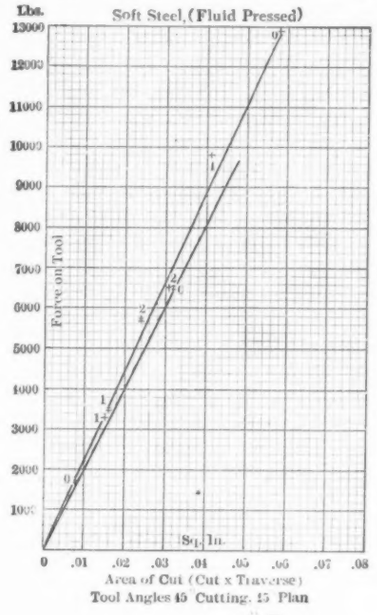

FIG. 14

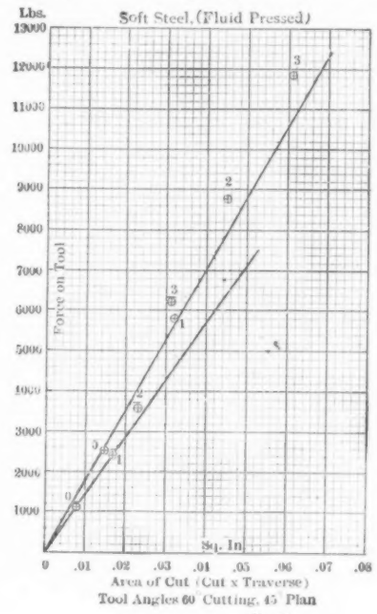

FIG. 15

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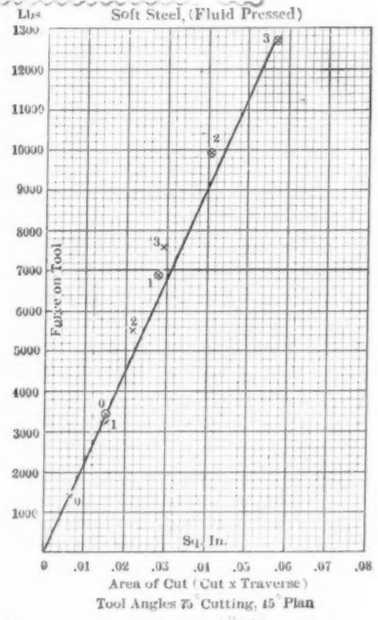


FIG. 16

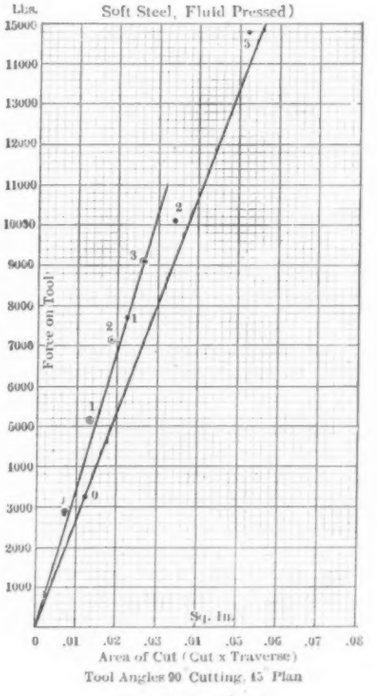


FIG. 17

TESTS ON MILD STEEL.

Figs. 10 to 19. Figs. 10 to 13 refer to medium gray-iron and the others to soft (fluid-pressed) steel; these being the only materials so far used in these trials. The former material is somewhat harder than ordinary shop gray-iron, while the latter is a tough but not very hard steel.

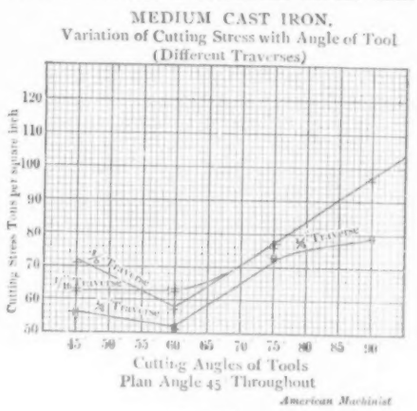


FIG. 18.

For both gray iron and steel it was the intention to make trials with each of four different traverses: 1/16, ⅛, ¼ and ⅜ inch, and with four depths of cut for each traverse: ⅛, ¼, ⅜ and ½ inch. This scheme was carried out in the case of the gray iron, so far as was possible with the means available, for each of the four cutting angles of 45, 60, 75 and 90 degrees.

The cutting stresses, which are obtained by dividing the observed vertical cutting forces by 2,240 and by the area of the cut, have been averaged for each traverse and tool angle in Figs. 10, 11, 12 and 13 and the results obtained have been plotted in Fig. 18, as ordinates on a base of cutting angles.

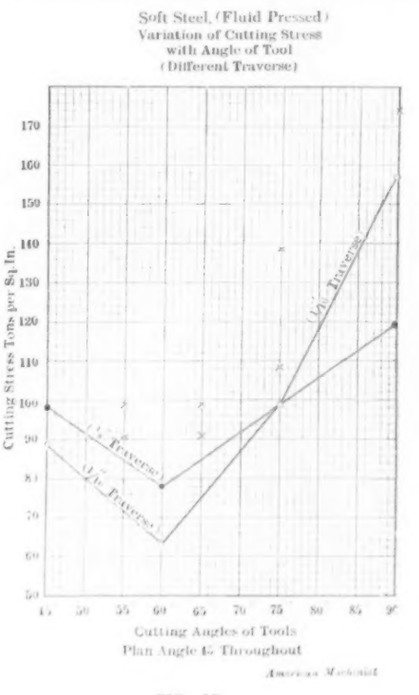


FIG. 19.

This plate indicates a somewhat lower

stress for wide than for fine traverses, altho this conclusion does not appear to hold in its entirety, especially for the keenest cutting angle used (45 degrees). It may be pointed out that the spots plotted in Figs. 18 and 19 are not single experiments, but are the average stresses for all depths of cut deduced from the sloping straight lines of Figs. 10 to 13 (or Figs. 14 to 17 for steel). These sloping lines are drawn so as to allow for the differing degree of sharpness of the tool used in each experiment depending on the number of previous runs it had had. [The small figures at each spot on the last-mentioned Figs. indicate the number of trials on which the tool had already been used without regrinding.]

The lines are drawn straight in Figs. 10 to 12, as expressing the conclusion, which is the simplest that can be obtained as a first approximation to the observations, that for a given traverse the cutting force is simply proportional to the depth of cut, or that the cutting stress is constant for a given width of traverse and given tool angle. The positions of the spots in Fig. 18 may therefore be viewed with some degree of confidence in regard to their accuracy. The variation of the cutting stress with the cutting angle is very marked. It varies by nearly 100 per cent. of its smallest value, which takes place, in every case, for a cutting angle of about 60 degrees. As subsequently shown, however, this angle of minimum cutting force is by no means that of greatest durability. A cutting angle of 80 degrees is that indicated as being best for shop use, and the cutting stress for this angle is about 75 tons per square inch.

The variation of the cutting stress with the traverse in the case of soft steel is somewhat complicated. For keen cutting angles (below 75 degrees) fine traverses require less cutting force than wide ones, while for blunt-nosed tools (*i. e.*, cutting angles greater than 75 degrees) the reverse is the case, and the fine traverse cut requires the greater effort to remove. At a cutting angle of 75 degrees the stress is the same whether the traverse be 1-16 inch or ⅛ inch, and has the value of about 100 tons per square inch. It is curious to remark that this angle of 75 degrees is also about the best angle for shop use, as shown by the durability trials subsequently to be cited. We may therefore say, with some confidence, that the ordinary shop tool, when cutting soft steel of this quality, exerts a vertical force of 100 tons per square inch of area of cut removed irrespective of the proportion of width of traverse to depth of cut.

The oldest working clock in Great Britain is in Peterborough Cathedral, dating from 1320. The clock is not fitted with a dial, the time being indicated on the main wheel of the escapement, which goes around once in two hours.

Some Further Facts Regarding the Invention of the Link Motion.

BY W. L. CAMPBELL.

But little is known regarding the life and career of William Williams, whom the testimony of Ralph L. Whyte in an article at page 178 of this volume clearly proves to be the inventor of what is known as the Stephenson link motion. What few references have been made to Williams in works on the locomotive have been most meagre. With the object of learning more, if possible, of this brilliant lad, I communicated with Messrs. Robert Stephenson & Co. and received from W. H. Crow, the present works manager, the following reply, which, in its corroboration of Mr. Whyte's statements and the facts it gives regarding Williams, is of considerable value. Mr. Crow writes:

"The copy of the AMERICAN MACHINIST which you sent to Messrs. Robert Stephenson & Co., Limited, is most interesting. As one of the present staff of the firm I am glad to learn that one of its old officials, Mr. Ralph L. Whyte, is still living. His recollections of the invention of the link motion agree with all that I have heard of its first introduction.

"'ORIGIN OF THE LINK MOTION.

"'William Williams when serving his time at South street made a small model of brass and iron connecting the two eccentric straps together with a straight link, thus (Fig. 1). The model Williams made clearly proved in its form the arrangement would not work, but the principle remained, and to avoid the expense of making another model in iron and brass he employed Howe, who was at that time a working patternmaker, to make him one in wood, with the eccentric rods between the link thus (Fig. 2), the connecting link *A* being movable for reversing and expansion, very similar in every respect to what is now known as Gooch's motion. Howe at once saw it would simplify the arrangement by carrying rod and link forward to valve spindle as now done, and avoiding the connecting link *A* and made the model accordingly, and showed the invention to Hutchinson, claiming it as his own. I was then a pupil at South Street, and working in the pattern shop at the time this occurred, and was the first person to whom Howe showed the wooden model. Howe subsequently submitted it to Mr. Hutchinson, and it was adopted. It would be more creditable to the origin-

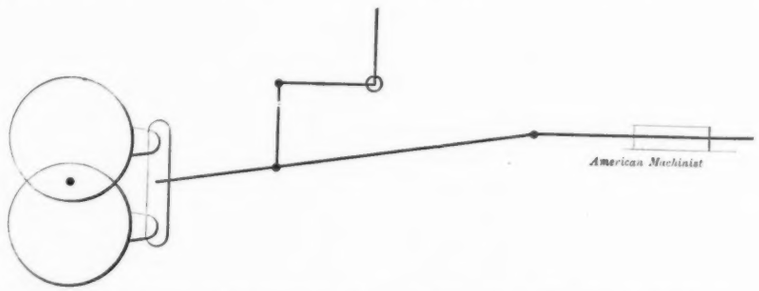


FIG. 1. WILLIAMS' FIRST SKETCH OF LINK MOTION, ACCORDING TO DOUGLAS.

"I have a drawing before me of a locomotive, signed with Mr. Whyte's initials, 'R. L. W.' and dated October, 1841. This drawing shows an engine fitted with the gab or fork motion, and on the same drawing is shown in red lines the link motion. The alteration to the link motion would no doubt be made after this date, and I think bears out Mr. Whyte's statement that he had laid down on paper the first link motion.

"In the year 1870 Mr. N. P. Burgh started a 'Link Motion Testimonial fund for Mr. Wm. Howe, the Inventor.' Whether this presentation was ever made or not, I do not know; but it was the means of bringing about a deal of controversy as to who was the real inventor. Mr. George Douglas, who was at that time general manager of the old Stephenson's works, at South street, Newcastle-on-Tyne, and who was also a pupil along with Williams under George Stephenson, gave me his statements of the facts of the case in writing; these I have before me now, and I give you them just as they are, in the hope that they may throw some light on the subject:

ators of the Link Testimonial Fund if they raised a subscription to erect a monument over the remains of the late Mr. Williams.'

"From the foregoing I think it will be clear that the balance of evidence goes to prove that Williams first conceived the idea of a link reversing and expansion motion, and not only that, but also that the model Howe was commissioned to make was a workable one, and that without detracting in any way from the credit due to Howe for his ingenuity in simplifying the arrangement, the origin of the link motion was due to the genius of Williams, as he had suggested it and designed and carried out a thoroughly practicable motion.

I regret that I have no information as to Mr. Williams' after career. He has, however, been dead for many years. Mr. Howe afterward became engineer at Clay Cross Colliery, and died somewhere about 1880. Yours faithfully,

"W. H. CROW,
"Works Manager."

Mr. Crow's letter was sent to Mr. Whyte, who was much interested and pleased in reading it. Mr. Whyte, how-

ever, claimed the statement of George Douglas to be erroneous in its references to the models of the link motion made by Williams and Howe, and adheres firmly to the facts as contained in the previous article on this subject, which has been referred to. His exceptions to parts of Mr. Douglas' statement he sets forth in a letter here reproduced:

"The letter of Mr. Crow was a very pleasant remembrance of the days of the past. Both Mr. Crow and George Douglas are old friends. George Douglas was in the office and I taught him drawing.

"I am very much pleased with the facts of the letter of Mr. Crow, because of the careful search made and facts found which are reliable.

"The statement of Mr. Douglas, however, is a very strange mixture of fact and error. Mr. Williams never made a model of brass and iron and never gave Mr. Howe a 'commission' to make a wooden model of the motion shown in the second drawing. The only model at all (wood or otherwise) which figured in the matter was the one Howe made after his conversation with Williams and showed to Mr. Hutchinson, with the statement that it was his own invention. And this model was not once seen in the drawing office from the time of Williams' inception of the link motion to the time the motion was laid down full size. The sketch Williams took to Howe, at my advice, was a pencil sketch, not larger than the palm of my hand, showing only the two eccentrics and the link coupling the two. The inspiration was the link, not the eccentrics. The link was to replace the gab or fork motion, and Williams had not the first thought as to the motion shown on his sketch being practicable for use in that form. The link at first sight struck me as a flash of genius; so much so that I wanted it to be in the hands of Mr. Hutchinson as quickly as possible, and all that was required of an honest man could have been done in an hour. Howe made a model, but did not give it to Williams, as he was directed to do, but took it direct to Mr. Hutchinson, stating that the link was his own original invention. So when, a couple of mornings later, I was informed by Mr. Hutchinson of the wonderful discovery of Howe, that man stood revealed to me in his true light, and I did not hesitate to denounce him as a master in falsehood to Mr. Hutchinson. After that morning, and during the two weeks I remained with the Stephensons to lay down the link motion full size, Howe's name was not mentioned by either Mr. Hutchinson or myself. When Williams brought his sketch to me, during our conversation there was no other thought in our minds than taking the old gab or fork motion bodily out of its place and inserting the link motion in its stead, and that is what I had done when the drawing was ready for investigation by Mr. Robert Stephenson. *Mr. Howe did not make a single alteration in the link motion that was not talked over between Williams and myself before he went to Mr. Howe* to have the little model made, and it is my conviction that Williams, with his generous, open nature, let Howe into many, if not all his thoughts about the link motion, to his own great sorrow afterwards.

"After I left the employ of Robert Stephenson & Co., when the finished draft of the link motion was completed, I could not say that any alterations were or were not made. But in the drawing I left the eccentric rods extended right to the valve stem. This first draft of the link motion could have been done in half a day, but we tested it in every conceivable position, and it was amazing what a difference a little change in the hanging of the link would make; so our experiments had to be multiplied. I have reason to think, however, that the link was put on the first engine pretty much or altogether as Mr. Hutchinson and I left it. I don't know how long it was before Robert Stephenson came down from London to give his sanction. But the fatherless lad, Williams, went under in the fight.

"R. L. WHYTE."

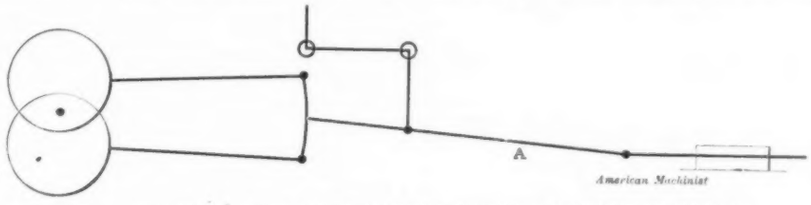


FIG. 2. WILLIAMS' FIRST MODEL OF LINK MOTION, ACCORDING TO DOUGLAS.

The letters of Mr. Crow and Mr. Whyte will form a valuable acquisition to what has been written on the invention of the link motion. What little light there is thrown upon this subject in locomotive history, however, would seem to sustain the stand taken by Mr. Whyte in connection with George Douglas' statement. As mentioned in the previous article referred to, *The Practical Mechanic and Engineers' Magazine, of Glasgow,* in April, 1846, published a description and illustration of the locomotive link motion, the invention of which it attributed to Mr. Williams. The May issue of this magazine stated that a communication had been received from Mr. William Howe, of Newcastle, claiming that he was the inventor of the link motion, but explaining that he was indebted to Mr. Williams for the original idea of the link. Howe forwarded a drawing of what he termed Williams' scheme. This showed the two eccentric straps connected by a straight link, practically the same as Fig. 1. This drawing was the same, or a copy of the one shown by Williams to Mr. Whyte. In his communication to the Glasgow magazine Howe makes no mention of the second sketch or model shown in Fig. 2, nor is this sketch shown in any subsequent works on the locomotive. As it may be assumed from Mr. Douglas' statement that Mr. Williams was living till near the year 1870, it would seem hardly possible for Howe to publish drawing No. 1 and ignore drawing No. 2, had there been such, without some sort of protest from Williams.

As has been stated, Williams was a modest, unassuming lad, and after Mr. Whyte, with whom he had discussed the full possibilities of his invention, had left for France, the only actual proof left of Williams' connection with the link motion was the little sketch which was in the hands of Howe, and, under such conditions, it is easily seen how the credit for this great invention could have been diverted from the young apprentice to the head patternmaker.

Getting the Best Machinery.

The following is from a paper in *The Clay Worker* read before a convention of brick manufacturers by Mr. E. R. Frazier, of Chicago; but it might mostly have been addressed quite as pertinently to, say, a convention of machine builders. I have been asked, he says [we curtail his remarks], to say a few words about "The Advantage of Good Machinery." On glancing at the topic, my first thought was, "That's easy"; but on second thought it occurred to me that the Committee on Topics might have had some experiences to the contrary, and upon turning over some leaves of experience of my own, I was confronted with some evidence easily establishing the fact that there were some who did not acknowledge that there was an advantage in good machinery, because they had deliberately purchased machinery of inferior quality, buying certain kinds purely and simply because of cheapness in price, seemingly on the ground that anything would do. I do not mean to include in my criticisms those who, when in the market, bought the very best obtainable, yet which shortly after became inferior in comparison with later apparatus. The man will succeed who, no matter how short the time he has been using his latest purchase of tools, upon discovering improvements, hastens to discard the old and establish the newer devices. You may say that this takes a great deal of money—granted. But it is a penalty attached to manufacturing in these days and is accepted by all the successful manufacturers, not alone manufacturers of brick, but manufacturers of all kinds, and I know of certain manufacturers who have made several changes in a few years,

each time throwing into the scrap heap apparatus which had been in use scarcely one year, and which when installed was the very best obtainable, and these parties, when spoken to about what seemed extravagance, had to say in defense only that "the machinery is out of date; so and so has perfected such improvements that in using them great saving is effected, and if we are to meet competition, and as we are in business to stay, and for profit, we could not do otherwise than introduce these improved tools and throw out the old ones." No, I have no criticism for such, but rather words of unlimited praise, and hold them up as people worthy of imitation. But we must criticise those who, when buying machinery, do not buy the good of the kind they are buying; those who seem to be looking for the cheapest to be had, pretending to do the work the prospective buyers have in mind to do, for they ignore the principle underlying our theme, and from the very start they labor under the disadvantages arising from competition with manufacturers possessing the good machinery, and soon are far behind in competition, with the day of failure close at hand.

I have many among my list of acquaintances who openly acknowledge that, through mistaken ideas, they attempted to start into the business with what they regarded as "cheap machinery," and found it was the indirect cause, at least, of their losing a great deal of money during the first year or two, and they realize this difference when they come to the point of buying a better class of machinery. I have a case in mind, where the parties stated that they would have saved several thousand dollars if they had put in certain machinery, naming it, which was generally known to the trade as being superior to that which they had first installed. The loss was not only in broken machinery and the expense of repairing the same, but through the interruption of their works, and loss of prestige with their trade through inability to fill contracts. The pay roll and fixed charges went on just the same, whether they made brick ten hours per day, or whether they were broken down and made brick only three or four hours a day.

System for Storing and Caring for Patterns.

BY R. S. CHEMIN.

The care of patterns is at best a perplexing problem, bad enough in an establishment where but one line of work is carried on, but increasingly difficult as the variety of work increases. The system here described is one which has been developed as the result of several years' experience, is now in use by a large corporation operating properties of several kinds, and is specially adapted to a very diversified line of patterns.

The subject may be divided into five heads: Making, handling and shipping, accounting, indexing and storage. The first, making, does not fall within the scope of this article.

Patterns, as completed, are numbered consecutively and turned over to the drafting department, which has general charge of patterns. After examination to make sure that the pattern agrees with the drawings, has number stamped on every removable piece and has raised figures to identify the castings, the pattern is entered in the pattern book. This, the only bound book used, is a common cloth-bound book of 200 pages. In the left margin, four lines apart, the pattern numbers are stamped consecutively, and in the space opposite, the title and a rough sketch of the pattern. These sketches are merely for identification of the pattern, reference being made for details to the original print or drawing on file. Each book contains only 2,400 patterns, but the use of several light books is preferable to one ponderous volume, because the light book can be carried to the pattern, if necessary, instead of bringing the pattern to the book, while if cards are used, one will, in the best regulated offices, occasionally be lost when taken out for reference. The numbering of patterns consecutively, rather than by any other system, simplifies the entire routine.

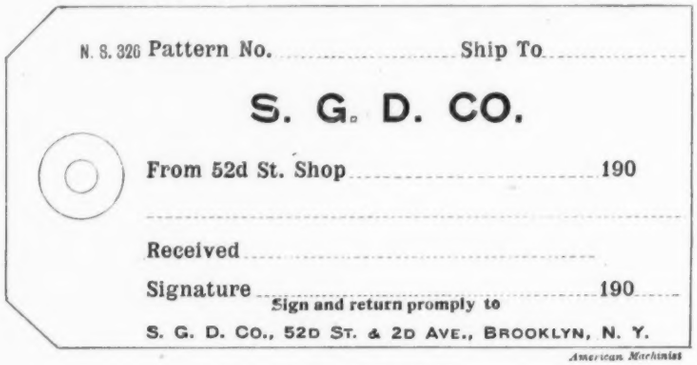

N. S. 326 Pattern No. Ship To
S. G. D. CO.
From 52d St. Shop 190
Received
Signature 190
Sign and return promply to
S. G. D. CO., 52D ST. & 2D AVE., BROOKLYN, N. Y.
American Machinist

FIG. 1. TAG FOR PATTERN.

When a pattern is to be shipped, a tag, Fig. 1, is attached to it. These tags are Dennison's "G" quality and cost, in lots of 2,000, $1 per thousand, printed and with string attached. The date and name of foundry are inserted by rubber stamps, and an abbreviated title is written in. The title is for convenience only, and might be omitted. A receipt, Fig. 2, has the date and name of foundry inserted at the same time as the tag, and is signed by the messenger or drayman who delivers the patterns. When the tags are returned, signed, by the foundry, the corner of the corresponding receipt is clipped, unclipped corners thus indicating delinquency either in delivery of patterns or in return of tags. The foundry is notified, after a few days, of such delinquency.

The tags, as received, are sorted according to foundries, and filed vertically in numerical order, in shallow drawers, one drawer for each foundry. The tags in any drawer represent all the patterns at that foundry, except those for which tags are in transit. Upon the return of a pattern receipt is given on a form similar to Fig. 2, the corners of the carbon copies of these receipts being clipped as the corresponding tags are removed from the drawers. The date of return is stamped across the face of the tag, and it is filed in another drawer, which contains a history of the travels of each pattern, one tag for each trip it has made to a foundry. This completes the accounting, every operation being fully checked, yet without unnecessary clerical work.

Next in order is the indexing. The ideal indexing system provides means for finding readily the number of any pattern when its name or its use is known, and for ascertaining whether there is in stock a pattern which can be used for a given purpose, whether originally made for that purpose or not. This end has been attained in a very satisfactory degree by a modification of the decimal system of classification, familiar by its almost universal use in libraries. The principal classes of patterns, corresponding to the various departments of work, are given numbers 10, 20, 30, etc., up to 90; divisions of these classes are numbered in the units place, and subdivisions in the tenths place; this can be carried out to hundredths and thousandths, but that will seldom be necessary. Thus, suppose one of the classes, 30, is "Shop Machinery and Tools"; it could be divided into 31, Machine Tools; 32, Wood-Working Machinery; 33, Hand Tools; 34, Dies; 39, Other Shop Machinery and Tools. Division 34 could be divided into 34.1, Bulldozer Dies; 34.2, Steam Hammer Dies; 34.3, Press Dies; 34.9, Other Dies. If division 34.1 happened to be specially large, it could be subdivided into 34.11, Bulldozer Dies for Structural Shapes; 34.12, for Pipe Hangers; 34.19, Other Bulldozer Dies. The ninth division is always reserved for "other" patterns, as in the examples above. This decimal classification should be carefully prepared for the particular business to which it is to be applied; but once the classes are laid out, it will be found easy to use and very flexible.

The class number of each pattern is written in the margin of the pattern book, below the pattern number, in smaller figures,

and is checked when entry is made on the index sheets. Some patterns may be entered under two or more heads, and in case of any uncertainty as to which of two classes a pattern belongs in, it should be entered in both. The index sheets are ruled bond paper, 8⅝x12 inches, with holes punched in the left margin for fasteners. At the head of the sheet is written the number and name of division, thus: "31.3, Planers," and all patterns in this division are entered, number and title, in suitable ruled columns. India ink is used, so that blueprint copies of the whole index, or of given classes, may be made for the foremen, order clerks, or others. These sheets are bound, in numerical order, in a Shipman Common Sense Binder No. 128½, with an outline of the classification on the first pages. The sheets cost 45 cents per 100, ruled and punched to order. To find a pattern—a commutator nut, for example—the outline is consulted and the class "40, Motors" is selected, next the division "43, Armatures" and subdivision "43.6, Commutators." Turning to the sheet headed 43.6 a list of all patterns for commutators is found. A novel feature is the "90, General Utility" class. In this

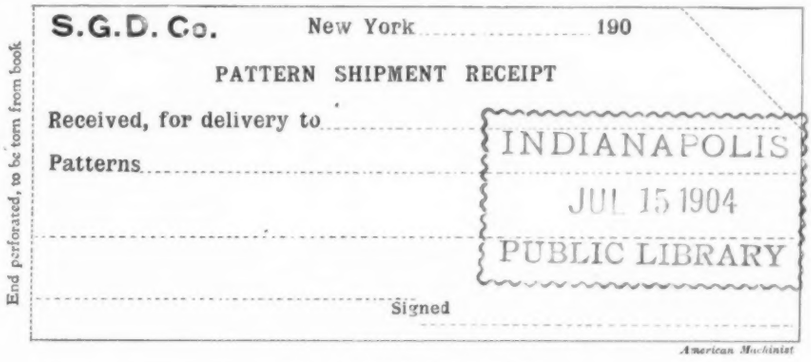


FIG. 2. RECEIPT FOR PATTERN.

class are listed patterns which, while already indexed under the divisions for which they were originally made, may be useful for other purposes. Under "92, Gears and Sprockets" will be listed lathe gears from 31.2, brush-holder sprockets from 43.4, hoisting-engine gears from 63.2, etc. The draftsman, in designing new apparatus, or the shop foreman with a breakdown on his hands, has thus for reference a complete list of all gear and sprocket patterns in stock. Other divisions of the 90 class are pulleys, rods, disk shapers, tube shapers, bearings.

There remains only the storage of the patterns. The arrangement adopted in this case is adapted to a large range of sizes. Tiers of shelves, five high, preferably of fireproof material, are provided, divided by transverse partitions into sections five feet long, each section numbered 3400, 3500, etc. An open room, with hooks on walls and ceiling, is also provided, this being divided by painted stripes on floor, walls and ceiling into sections numbered 1, 2, 3, etc. The patterns from 3500 to 3599 are stored, as far as there is room, on the shelves of section 3500; the overflow of large patterns is stored in the open room, much space being saved by storing similar patterns such as pipe flanges or floor plates together regardless of their numbers. In each shelf section is a covered box for very small patterns, and a heavy card on which are written the numbers of all patterns removed to the open room, and opposite each the number of the section where it may be found. A person wishing to find pattern 5369 can get a general idea of its shape and appearance from the sketch in the pattern book, and has then only to look through the shelves of the 5300 section.

In conclusion it may be said that originality is claimed for few of the features of this system. It has grown, step by step, through the necessity for keeping accurate account of patterns, avoiding duplication, economizing space, and at the same time avoiding elaborate clerical work. It is believed that this system gives a maximum of accuracy and convenience, with a minimum of labor.

Collapse of a Molding Sand Bonanza.

When anyone attempts to run a foundry in a new country he is confronted with many difficulties. One of these is the molding sand problem, which frequently is a troublesome one, especially in a country where clay predominates and sand is an extremely scarce article. Some years ago two small foundries were located on opposite sides of the street in a Western town. Both of them obtained their molding sand from a distance. One of the foundry properties backed upon a water front; and in connection with some improvements being made, when one morning a tramp lounged in asking for work, the foreman of the foundry put him to digging a hole in the bank back of the foundry. After working a short time the fellow came to the foreman and called his attention to the fact that there was a small streak of sand in the side of the bank which looked to him "just like the dirt they were hauling in on the cars." The foreman took some of it into the foundry, tested it, and found it was, as the tramp had thought, molding sand, and of good quality. He told the man to get all he could of it and wheel it up and put it into the sand shed. He then forgot about the matter entirely.

A little over a week later, in passing the sand shed, he noticed that it was as full of sand as it could hold, which surprised him considerably. He called up the man who was still working at the excavation, and asked him where he got all that molding sand. He replied that he had followed the seam back into the bank. The foreman then went to the bank and found that the workman had excavated so far that he had a tunnel following the seam out of sight into the bank. While they were talking, from the rear end of the tunnel out came the foreman of the foundry across the street, and a madder man it would be hard to find. He wanted to know (with a little brimstone vocabulary) what on earth they had been undermining his foundry for! Bewilderment was succeeded by explanations, and upon investigating the matter they found that the tunnel extended across the street and under a corner of the opposite foundry. The rival foundrymen had just completed an extra large mold to their satisfaction, when they were mystified and chagrined to see it crumble, lose its shape and sink into the earth. The foreman thought this was a seismic disturbance that demanded scientific research, and that at once, and on exploring the operations he had come through to the opening of the tunnel. Considerable difficulty was experienced in settling up the matter, but it was finally arranged that the foundry which had dug the sand should deliver half of it to the other foundry and that they should also fill up the hole. As a consequence, one foundry got a good supply of molding sand for nothing and the other was put to quite an expense to fill the tunnel.—*The Foundry.*

Richard Guenther, United States Consul General at Frankfort, reports that some of the largest German joint stock chemical companies declared from 24 to 26 per cent. dividends on their share capital last year, besides carrying heavy amounts of their earnings to reserves and liberally writing off on their real estate and manufacturing plant. In the manufacturing of dyes (the product of coal tar, etc.) the German chemical works have almost a monopoly, supplying, as they do, their industrial competitors (England, France, Belgium, the United States, etc.). The same may be said of synthetic indigo, which at this day already supplies more than one-half of the world's entire use of indigo and will before long drive the natural article out of the market. A German chemical factory is now manufacturing synthetic camphor after a new process of its own, which, it is said, will have the same effect upon the camphor market as the introduction of the artificial indigo has had upon the indigo market.

Making Gas-Engine Pistons.

BY R. F. GARLAND.

That defective gas-engine pistons are the cause of a good share of the engine builders' troubles, is a well-known fact, and to overcome these troubles the Charles A. Stickney Company, St. Paul, with whom I am employed, has spent considerable time and money. My intention is to describe the tools and methods we have for doing this particular work. The piston which I will refer to is for a vertical gasoline engine with a cylinder of 5 inches bore.

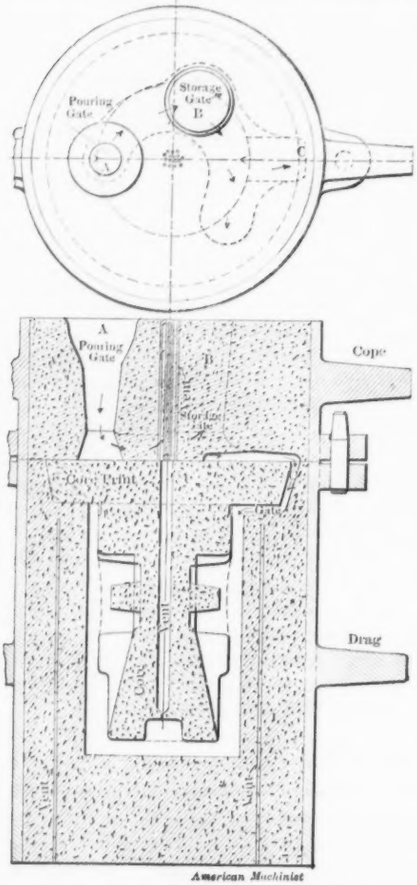


FIG. 1. COMPLETED MOLD FOR PISTON.

Fig. 1 shows the mold, which is made on a molding machine. The casting is made with the open end up to insure its being solid at the head end and where the ring grooves are afterwards cut. The figure shows the method of supporting the core and arranging the pouring gate, etc. The object of this arrangement is this: The iron enters at the pouring gate *A* and flows in the direction of the arrows and fills the storage gate *B*, and from there it flows into the mold proper through gate *C*. The gate is small in area at *C*, this tending to retard the flow of the iron somewhat, and it rises in the storage gate *B* carrying the dirt and slag with it. The flasks are of iron with the pins arranged in the usual way for molding machine work of this character. It should be noticed that the core does not cut through where the piston pin-hole is to be bored. The cores are dried in iron core-shells, and are in one piece. The castings are rattled and do not require any chipping, and come from the foundry very uniform as to shape, size, thickness of metal, and grade of iron.

Fig. 2 shows the finished piston. There are three grooves at *A* for snap rings, and an oil grove at *B;* the holes *C* are for pins to prevent the rings from turning around, and an oil tube is driven in the hole *D* for oiling the connecting-rod bearing. The hole *E* is drilled and tapped ⅝ inch for holding in the chuck.

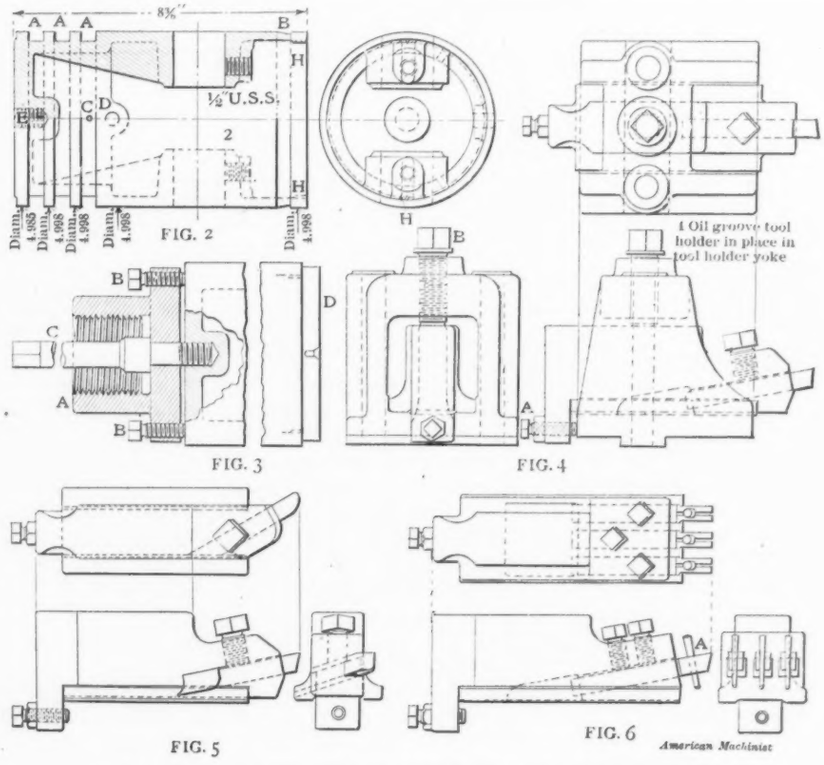
Fig. 3 shows the method of chucking. A steel face-plate *A* is screwed on to the spindle of a 16-inch engine lathe. This plate is 5.010 inches in diameter, and has four ⅜-inch steel set-screws tapped through it near the edge at *B*. These set-screws serve to true the piston up, and their cup points dig into the casting somewhat and help to drive it. The face-plate has a ⅝-inch hole through the center and the rod *C* is run through the hollow spindle of the lathe and through this hole and screwed into the piston. This rod has a square head on the outer end which reaches beyond the rear end of the lathe spindle. In chucking a piston it is held in position with one hand and with the other the rod is screwed into it until the head of the piston comes in contact with the points of the set-screws which project slightly beyond the face-plate. The piston is then trued up by adjusting the set-screws, after which the rod is drawn up tight. It may be said here that the chucking hole in the piston is drilled fairly central, hence the piston runs true enough at that end, it only being necessary to true up the outer end by means of the set-screws in the face-plate.

The chuck hole is drilled and tapped in the pistons by the lathe hand while his lathe is in operation on one previously drilled, hence there is no expense attached to this job other than the tools necessary for doing it, which consist of an old 14" x4' lathe with a three-jaw universal chuck mounted on the carriage and a drill held in the spindle, and a bushing in the chuck to guide the drill. This takes care of the drilling and, for tapping, the piston is held in a vise bolted to the lathe bed and is tapped by hand.

After the piston is trued up in the lathe, it is faced off straight or flat on the outer end, and a steel plate *D* having a center in it is held against this face by the tail-stock center. This prevents chattering during the heavy roughing cut which follows.

This method of chucking has proved a great success, as it is very quickly done. It allows the tool to travel clear across the casting and does away with a large clumsy chuck to handle. It is far superior to chucking by the open end, as it does not spring the casting in the least, and it provides an easy means of truing up.

The tools used in turning the piston are of self-hardening steel held in gray-iron tool-holders which fit into a yoke, Fig. 4, bolted to the tool carriage. These tools have adjusting screws, shown at *A*, which are set when the tool is ground. The tool-holders are very quickly changed for the different operations and are held securely in place by the screw *B*. The tool shown



THE FINISHED PISTON, MODE OF CHUCKING, TOOL-HOLDER AND TOOLS.

in Fig. 4 is for forming the oil groove. Fig. 5 shows a turning tool; two of these are used.

Fig. 6 shows the gang tool used for finishing the ring grooves. The tools are provided with adjustment to maintain the standard width of grooves. This adjustment is secured by having each tool split and a taper pin driven into a hole as at *A*. Solid tools in another holder rough out the grooves. The tool-holders all fit into the yoke, Fig. 4, and are set by the adjusting screws so as to cut to the approximate diameter when the tool slide is fed in to the regular stop provided on the lathe. It will be seen that by this method of holding the tools there can be no time lost in setting each tool, as when the tool-holder is slid into place and the screw in the yoke is tightened up the tool is set in the correct position as to clearance, rake and depth of cut. The face-plate *A*, Fig. 3, is 5.010 inches in diameter, which is the size the pistons are turned, allowing .010 inch for grinding. This assists the operator in adjusting his turning tools, after grinding them, for the depth of cut.

The lathe work on these pistons, which includes drilling and tapping the chucking hole, chucking, facing the ends, running two cuts over the casting, and turning the ring and oil grooves, is done by a boy at the rate of twelve per day of ten hours, working on the premium system.

After these pistons leave the lathe they are tested. For this job we use an arbor press. The piston is filled partly full of gasoline, and a gray-iron plate with a soft leather face is placed over the open end and to this is attached a compressed air hose. The piston and plate are then placed in the arbor press and the air is turned on. It, having a pressure of 80 pounds per square inch, forces the gasoline through any sand holes or porous places which are sometimes found in the casting around the ring grooves. Pistons which show any leakage are discarded.

The pistons are now ready to be bored for the pin-holes. This is done in a 2x24-inch Jones & Lamson flat turret lathe, as shown by the half-tone, Fig. 7. The piston is placed in a special chuck attached to the spindle, Fig. 8. The open end of the piston, which was previously faced, is placed in the recess at *A* and the screw *B* holds it in place. It will be noticed that the piston has two small V-shaped projections cast inside of it at *H*. This may be seen more clearly in Fig. 2. These are made in the core and are on the center line and in line with the center of the hubs which carry the piston pin. The end of the chuck is bored out about the size of the inside of the piston and two arrow marks are placed inside of it at *C*. In setting the piston in the chuck, the notches inside of it are brought in line with the arrow marks in the chuck, and the screw *B* is then tightened. The chuck is made quite heavy at the end marked *D* to counterbalance the heavy end of the piston.

Referring to the half-tone, it will be seen that the tool in the turret which is in position is a twist drill. This is a 1⅜-inch Novo steel drill. After the drilling the long boring bar is swung into position. This bar is shown in Fig. 9. The bar fits the bushing shown in the chuck and bores the hole almost to size. After the bar is withdrawn the 1½-inch adjustable reamer is brought into position; this sizes the hole. It now remains to face the inside ends of the hubs. This facing is done with the two tools shown in the photograph in the turret next the reamer. The first is used for roughing and the second for finishing the faces. These tools are shown in detail in Fig. 10. They are both alike, the only difference being in the adjustment of the turret stops and the adjustment of the tool in the tool-holder. It will be seen that they are expanding tools. The body of these tools is made of machinery steel, case-hardened and ground to size; the large end fits the turret tool-holder and the small end is a running fit in the reamed hole in the piston. These tools, as well as the boring bar (Fig. 9), have grooves at *E* which catch the dirt and small particles of iron and prevent them from cutting. Oil is used quite freely on these tools, and we never have any trouble with their sticking or cutting in the hole.

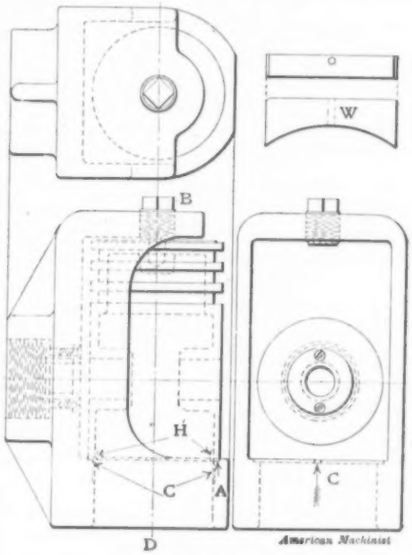


FIG. 8. CHUCK FOR PISTON FOR BORING CROSS PIN HOLES.

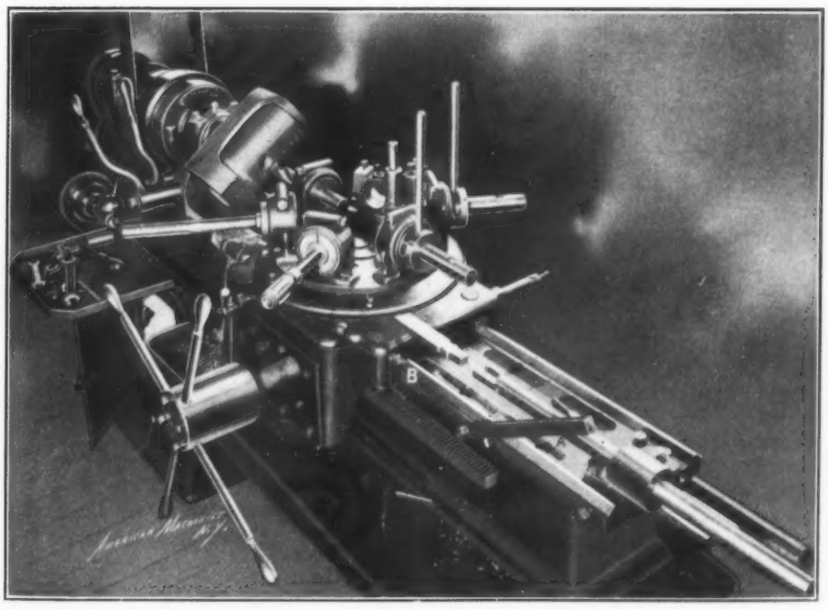


FIG. 7. BORING THE CROSS HOLE IN THE PISTON.

The body of the tool is bored out to receive the shaft *F*, which has an eccentric end at *G* which works in a slot cut in the cutter *H* and moves the cutter crosswise in the tool as the shaft is turned. The shaft is given a half rotation by means of the handle *I* working in the slot J. The cutter is in its extreme outward position when the handle is in the position shown in the figure at *I*. The two small buttons *K* act as stops to hold the handle in a vertical position when the tools are not in use. The buttons are held in place by the springs *L*.

In order to face both bosses with these tools a back stop is used for the turret. This stop will be seen in the half-tone at *A*. It consists of a flat piece of steel attached to the side of the lathe bed by a shoulder screw, and is free to be swung over on to the turret, and when the turret is drawn forward it drops down on the small angle-plate attached to the corner of the carriage at *B*. This stop is used when facing the boss nearest to the turret, and the regular stops are used when facing the other boss, the tools and stops being set to bring the faces the right distance apart and an equal distance from the center of the piston.

In operation the roughing tool is brought into position and the handle is thrown away from the operator; this draws the

cutter in flush with the body of the tool. The turret is then brought forward to the regular stop. In this position the cutter is set right to take the roughing cut off of the face nearest the head of the lathe. The cutter is then fed out by slowly drawing the handle over towards the operator a half-turn. The handle is then thrown back and the turret is drawn back against the special back stop. The cutter is then in the right position to take the roughing cut off of the face nearest the turret and the cutter is again fed out as before. Then the handle is thrown back again, the special back stop is lifted up out of the way and the tool is withdrawn. The handle is now brought up to a vertical position where it remains out of the way. The turret is then swung around, bringing the finishing tool into position. This is operated the same as the roughing tool, and it is adjusted in the turret so as to take the finishing cut off of the one boss when the carriage is against the special back stop and and the regular stop is adjusted to allow the tool to take the required amount of finishing cut off the other boss. It was necessary when mounting these tools in the turret to make a special extension hub for the pilot wheel in order to get far enough out to clear the boring bar. It is surprising how well these expanding tools work and how well they hold up. This machine is operated by a "handy" man and he turns out forty pistons in ten working hours, on the premium plan. The tools have finished over 3,000 pistons and the original cutters are still in them and are apparently good for as many more.

The pistons are now ready for drilling. other drill work, is done in our shop by using a separate drill press or drill spindle for each operation, the operator moving along from one press to the next as the operations are finished. We find this method saves much time over the method of changing tools, feeds and speeds, and in some cases changing the hight of the table and drill press head. Of course, when a certain jig is used for one hole only, or on one tool only, it might be best to finish all of this operation first and then proceed with the next operation in the same presses, but even this necessitates laying the pieces down on the pile and picking them up again, which takes considerable time in most cases.

At *W*, Fig. 8, is shown a jig used for drilling the taper pin-holes in the ring grooves. After these holes are drilled they are reamed with a No. 2 standard taper pin reamer. This work is done on a two-spindle sensitive drill press, the drill held in one spindle and the reamer in the other. A long V-block is bolted to the table and the piston is placed in this and turned around for the three different holes which are spaced approximately on thirds, and it is then slid along to the reamer. The oil tube hole is drilled with a V-block which has a bushing for the drill and a projecting lug which fits into the piston between the faces of the bosses.

The piston is now ready for grinding. This is done on a No. 11 Landis plain grinder. Fig. 12 shows the method of holding the piston in the grinder. The face-plate *A* is bolted to the head end of the piston the same as the face-plate on the engine lathe, only it has no set-screws for truing up, but, instead, has a true face and ground, is put in place and the plate *B* is put on and the long screws *F* are screwed down on to the pin and the nuts *G* are brought down against the plate. This plate has a steel center at *K*.

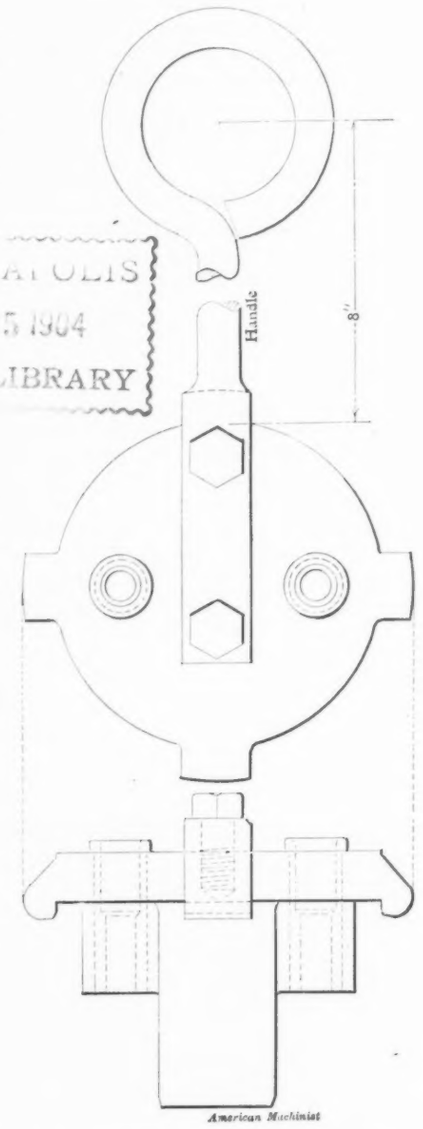


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FIG. 11. DRILLING JIG FOR SET-SCREW HOLES.

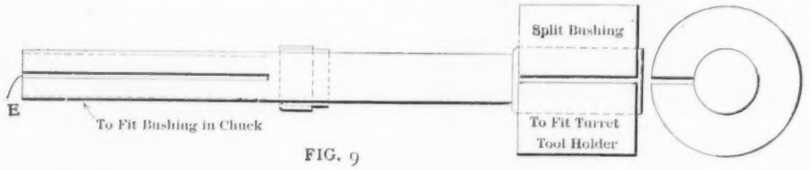


FIG. 9

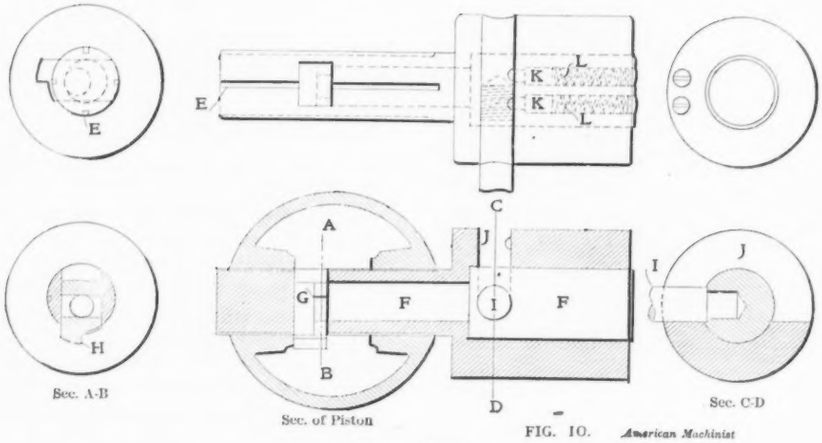


FIG. 10. American Machinist

BORING TOOLS.

Fig. 11 shows the jig used for drilling the bosses for the set-screws. After these holes are drilled they are tapped and the bosses faced for jam-nuts.

This drill work, as well as almost all which bears against the finished part of the piston head. This face-plate is in the form of a yoke with a steel center at *C* and a lug at *D* for driving it.

The piston pin *E*, which is case-hardened

Plates *A* and *B* are both the same diameter and a little smaller than the piston. The ring *H* is bored in one end to fit the piston and the other end fits over the face-plates. Before the plates are tightened on the piston this ring is slipped over them and the end of the piston; this brings the plates true with the ends of the piston. The plates are tightened down tight and the ring is removed. The operator is provided with two sets of these fixtures, and while his machine is grinding one piston he is putting the other set of fixtures on the next piston.

The object in tightening the screws *F* down on the piston pin is to have the strains on the piston as near as possible the same when being ground as when in

the engine, and as the set-screws draw the open end of the piston out of true slightly when in the engine we found it best to have them the same when grinding. The pistons are ground quite smooth and within a limit of one-half of one thousandth of an inch in diameter. The head end, or the space between the first ring and the head end, is ground about five one-thousandths of an inch smaller than the rest to allow for expansion.

We have found a decided advantage in using ground pistons, as it is practical to make them round and straight and within the limit mentioned above with medium-priced help at the rate of fifty per day of ten hours.

Specifications for Pig-Iron and Iron Castings.*

BY ROBERT JOB.

Up to five years ago the pig iron used by the Philadelphia & Reading Railway Company had been obtained solely upon the appearance of the fracture; but as the service was unsatisfactory, an investigation was made to determine the quality best adapted to the requirements of the company. It was found, in the first place, that the proportions of phosphorus and of silicon were high, which resulted in the castings having a rather low tensile strength and being weak under impact. After a study of the quality and conditions of the scrap of the company, as well as of the service desired, specifications were drawn up substantially in the form of those herewith appended, limiting the proportion of phosphorus to 0.5 per cent., and the proportion of silicon to about 1.5 per cent., holding the latter component in practise to about 1.75 per cent. also, as some of the scrap was rather high in sulfur, a minimum of 0.4 per cent. was placed on the manganese-content of the pig iron, and ferro-manganese was used in the ladle. The result of these changes was to produce a tough, close-grained, easily machined casting of high resistance under impact.

By the end of the first year after beginning to use this iron, the breakages had decreased to such an extent that the company's supply of scrap was largely cut off, and by the end of the second year the supply had decreased to so low a point that it became necessary to get the scrap for the cupola furnaces elsewhere, and to purify it by an additional treatment.

*Contributed at the Atlantic City meeting, February, 1904, of the American Institute of Mining Engineers.

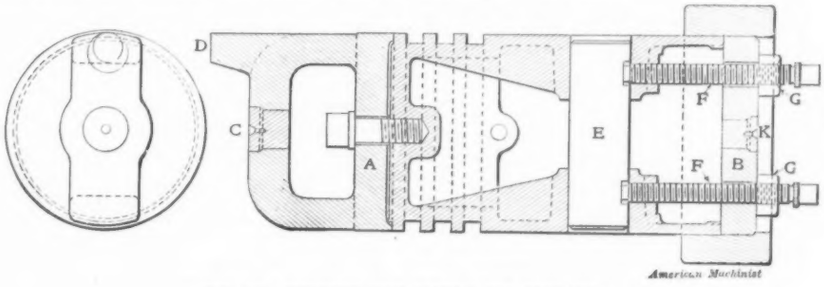


FIG. 12. HOLDING THE PISTON FOR GRINDING.

SPECIFICATIONS FOR IRON CASTINGS, PHILADELPHIA & READING RAILWAY COMPANY.

1. *Physical Requirements.*

All castings must be of uniform quality and of solid iron free from physical defects and excessive shrinkage strains, finished in a workmanlike manner, free from sand, and in close accordance with drawings. Castings purchased under Class 1 or Class 2 must be of gray iron throughout and easily machined.

2. *Chemical Requirements.*

Class 1. Medium Iron.—Engine cylinders, gears, wheel centers, smokestacks, etc. The iron must be close grained and tough. The composition must be silicon, from 1.4 to 2; sulfur, not exceeding 0.085; manganese, not exceeding 0.7; phosphorus, not exceeding 0.6 per cent.

Class 2. Soft Iron.—Small castings for general car and roadway use. The composition must be silicon, from 2 to 2.8; sulfur, not exceeding 0.085; manganese, not exceeding 0.7; phosphorus, not exceeding 0.6 per cent.

Class 3.—Brake-shoes and other castings for frictional wear. The iron must be hard and tough. The composition must be silicon, from 2 to 2.5; sulfur, not exceeding 0.15; manganese, not exceeding 0.7; phosphorus, not exceeding 0.7 per cent.

3. *Method of Inspection.*

Upon receipt of a shipment, a thorough inspection will be made, and only those castings will be considered which meet the requirements of Section 1. From such castings borings will be taken from at least one in each fifty or fraction thereof, and the composition must be within the stated limits or the shipment will be rejected.

4. *Rejected Material.*

All rejected material will be returned at the expense of the shipper, and all castings which fail in service owing to defects of manufacture must be replaced free of cost.

SPECIFICATIONS FOR PIG IRON, SUPERSEDING PREVIOUS SPECIFICATIONS, PHILADELPHIA & READING RAILWAY COMPANY.

1. *Physical Requirements.*

Shipments must be of uniform quality, and free from sand, dirt, slag or other foreign matter. Pigs must be broken, or be of such size as to be easily handled.

2. *Method of Sampling.*

Upon inspection, three pigs will be selected at random from each carload or fraction thereof, and a sample of drillings obtained by boring into the face of a fractured end of each of the three with a blunt, wide-angled, 2-inch drill, to a depth of not less than 2 inches, care being taken to have the drillings uniformly fine and free from sand or other foreign matter. The samples from these three pigs will then be thoroughly mixed, and this final sample upon analysis must conform to the following composition, or the carload represented will be rejected.

3. *Chemical Composition.*

The chemical composition must be: Silicon, from 1.5 to 2.5; manganese, from 0.4 to 0.75; phosphorus, not exceeding 0.50; sulfur, not exceeding 0.04 per cent.

4. *Rejection.*

In case of rejection at the shops, the material will be returned at the expense of the shipper.

Iron, Steel and Machinery Trade of the Philippines.

The figures covering the iron and steel trade of the islands for 1903 show an increased value as compared with the year of 1902, in which year it amounted to $2,140,456, whereas last year the value is given as $2,270,647. This was distributed in the main, as follows: United States, $557,327; United Kingdom, $822,104; Germany, $491,748; France, $142,778, and from all other countries, $256,690.

The iron and steel trade trade of the islands is miscellaneous in character. The improvement noticed during the past year has been due to an increased demand for railway supplies and a certain class of building materials. From a standpoint of value, sheets and plates are the staple commodities of import, the trade along this line having advanced from $224,141 in 1902 to $311,869 in 1903; 90 per cent. of that quantity was received from the United Kingdom. Purchases of structural iron and steel reached $71,108 in 1903, the United Kingdom supplying more than $63,000 worth, and this was more than double the quantity received from all sources during the previous year.

A consignment of $74,365 worth of steel rails from Germany and $61,420 from Belgium received during the latter part of last year, probably for use in the construction of the new electric railway of Manila, together with small shipments from the United Kingdom and other countries, nets an increase of more than $160,000 over 1902, when the purchases of rails for railways aggregated but $14,227. Under nails, spikes, tacks, etc., an increased importation is shown over 1902, occurring principally in the single item of wire nails, the trade in which advanced from $42,032 to $46,999.

and one-third of that amount was contributed by the United States.

German markets profited by the increased demand for sewing machines, shipments from that source reaching $109,686 in 1903, or 76 per cent. of the total; practically all of the remainder, $30,449 were shipped from the United States. Of the $15,560 worth of electrical machinery imported during 1903, more than $11,000 worth was received from the United States, as against transactions covering about one-fourth of that amount in 1902. It is reported that the iron-working plant recently established in Manila is doing an extensive business in the islands, and a number of orders have been placed for iron and steel wares ordinarily filled in the foreign markets. A large amount of repair work is done in this plant, thus avoiding considerable delay and expense incurred in having such work done abroad.

A. F. T.

There are seventy-nine municipalities in Ontario which own their water works, thirty-five which have their own electric lighting plants, four which supply electricity; two supply gas; two have municipal cemeteries; one possesses a dock, and one operates its own street railway. Profits are shown in forty-four cases and losses in forty-eight. In one case there was no profit or loss, and in twenty-three no reports were made. The municipal gas plant at Brockville, which was established in 1901, realized an annual profit of $4,000 on an invested capital of $85,000; but the natural gas sold by the corporation at Kingsville showed a loss of $243.38 on an invested capital of $27,000.

Giacomo Boni, the archæologist who is directing the excavations of the Forum in Rome, has found a heavy capstan, with eight fixed levers of wood. The wood is perfectly preserved, while the iron fixtures have become oxidized. This discovery is considered of the greatest importance, as being the first known mechanical contrivance dating back 2,000 years. The capstan, which was found almost intact, is over six feet in diameter.

Gasnier's New Electro-Mechanical Coupling and Speed-Varying Device.

BY E. P. BUFFET.

Existing devices for electrical transmission of mechanical power involve a complete conversion of the power into electricity. Evidently there may be some advantage in a system by which only so much of the energy is transformed as is necessary to vary the amount applied, a portion of the power being used directly in its mechanical form. It is with this end in view that Paul Gasnier has devised and described to the French Academy of Sciences a method of transmission which he calls electro-mechanical. We print herewith a nearly literal translation of his account of the apparatus.

The arrangement gives by simple means a continuous variation of the speed of the driven machine, from rest to maximum, and it presents an advantage over pure electrical transmission in requiring of the electrical machines only a moderate power, much less than the total motive energy—say a third or a fourth. This depends on the fact that a fraction (variable with the speed, but always important) of the motive power is directly transmitted from the driver to the driven shaft; the remainder of the motive power, only, is taken by a dynamo acting as a generator and restored by another dynamo* acting as motor.

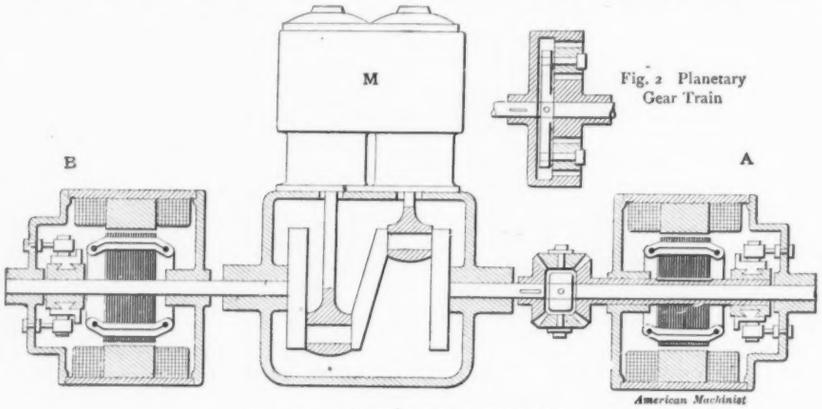


FIG. 1. GASNIER'S SPEED VARIATOR.

Because of the connection between the driving and driven machines this arrangement is particularly adapted to cases in which they are not far apart—for example, in automobiles. It is claimed then to be superior to pure electric transmission in point of weight and efficiency.

The principle of the electro-mechanical transmission is as follows:

A train of epicyclic gearing is so arranged that the driven shaft is actuated at the same time by the driver and by a dynamo, which I will call the coupling dynamo; these two machines being separate and thus being able to run at different speeds.

Let there be, for example, a train of epicyclic spur gears composed of a central pinion, a much larger gear around it, toothed internally, and, to connect the two, any number of planetary pinions turning on spindles fixed in a frame.

It suffices, essentially, to connect these three parts—outside gear, central gear and support of the planetary gears—each to one of the three elements—driver, coupling dynamo, driven shaft—to obtain the desired result.

Assume, for illustration, the outside gear connected with the driver, the inside one with the coupling dynamo and the support of the planetaries with the driven machine. Thus we get a combination which forms a new electro-mechanical coupling of continuous speed-variation. The state of uncoupling corresponds to an open circuit of the dynamo, which we shall suppose, for simplicity, to be excited from some outside source.

The driver turning at constant speed, and the driven shaft—*i. e.*, that connected with the support of the planetaries—being [sufficiently] fixed, the dynamo turns in an opposite direction to the driver. If then we close the dynamo circuit on a rheostat, it will become a generator, will decrease in speed, and the support of the planetaries will begin to turn in the direction of the driver. The current circulating through the dynamo is now creating in the central pinion a couple resisting the driven shaft.

The speed of the dynamo necessary to create this current will be more feeble as the resistance of the rheostat is less. When, at the limit, the dynamo is in short circuit, it will turn very slowly and the coupling will be obtained with the advantage of a speed reduction determined by the ratio of the exterior gear to the central pinion. With this arrangement we may realize all speeds from zero to maximum, but this will be done in a manner comparable with a slipping belt or clutch; *i. e.*, without increase of the driving couple as the speed decreases.

It is possible to avoid this loss of energy and to restore in mechanical power on the driven shaft, or if preferred on the driver, that which we have assumed to lose in the form of heat in the resistances.

To do this it is necessary only to suppress the rheostat and replace it by an opposing electro-motive force, variable and regulatable at pleasure, produced by a second dynamo placed either on the driving or driven shaft. Thus the simple electro-mechanical coupling that has been described is transformed into a true continuous electro-mechanical speed variator.

Let us consider, for example, a case where half the power of the driver—which is assumed to maintain constant speed—is absorbed in the rheostat. The motive couple acting on the driven shaft then approx-

*The term "dynamo" is used more commonly in France than in America to denote a motor as well as a generator. It has been found convenient in translating this article to follow that practise, owing to ambiguity in the functions of the machines described. Now that "dynamo" has been largely superseded by "generator" in a restricted sense, it is a pity that the French usage could not universally be followed. It would save much ink.—TRANS.

imately corresponds in effect to half the motive power. If on the driven shaft we place a second dynamo, and without changing the speed of this shaft we receive in this dynamo all the power that was lost in the rheostat, it is evident that we get—still with approximately the same expenditure—double the power formerly utilized on the driven shaft, without having had to change the speed; we have thus doubled the driving couple.

In the arrangement that I have constructed the second dynamo is attached to the shaft of the driver. When this dynamo offers an opposing electro-motive force of zero, the case is precisely the same as in the simple electro-mechanical coupling above described; the coupling dynamo being in short circuit turns very slowly. If now we excite the second dynamo so as to give it a gradually increasing electro-motive force, in opposition to that of the coupling dynamo, the coupling dynamo, after coming completely to rest, changes its direction of rotation, then turns in the direction of the driver and becomes itself a motor.

When its speed is equal to that of the driver, the gears of the epicyclic train do not work at all; they turn in block, the driven shaft having the speed of the driver. Under these conditions a part of the motive power is taken from the driver by the second dynamo and restored by the coupling dynamo on the central pinion; the rest of the motive power is transmitted directly by the exterior gear.

We may go further and increase still more the speed of the coupling dynamo, which will make the driven shaft turn more rapidly than the driver.

It is evident, says a foot-note to this description as published in the *Revue Industrielle*, that from the moment when the speed of rotation of the coupling dynamo is nothing to that when it has attained the speed of the driver, the driven shaft will have a movement more and more rapid. By suitably regulating the excitation of the two electrical machines starting from rest of the coupling dynamo, this may be made to turn in a direction contrary to that of the driver, with constantly growing velocity. The movement of the driven shaft declines till it becomes nothing. By further increasing the speed of the coupling dynamo a reversal of motion is obtained.

In Fig. 1, herewith reproduced, *M* is the driving engine, *A* the coupling dynamo, *B* the dynamo mounted on the driving shaft and wired in series with *A*. The mechanical coupling shown in the figure is a train of bevel gears which, however, may be replaced with a planetary system (Fig. 2) in accordance with the foregoing description. The method by which the driving shaft is connected with the gearing is a matter of detail not shown in the figures.

The Dutch name for the automobile is said to be "Suelpaardelooszonderspoorwegpetroolryting."

Letters From Practical Men.

A Proposed Graduation for Micrometer Calipers.

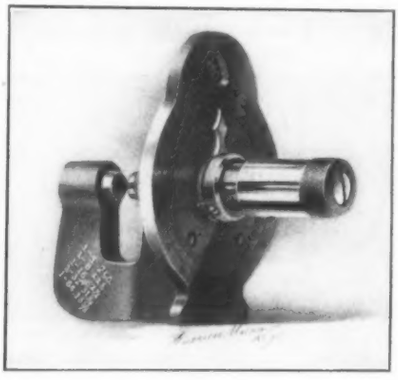
Editor American Machinist:

As a reader of and subscriber to the AMERICAN MACHINIST for about twenty-three years, I take pleasure in writing you that of the many good points and information which I have gotten from your valuable paper, none have interested me more during the past few years than the articles on "Die Work" and "Micrometers."

S. A. Moss' article at page 689 is most interesting to me and I agree in every way with Mr. Moss' suggestions in regard to the difficulty in reading the scale on micrometers as they are now made.

It would certainly simplify the reading very much if, as he says, the screw thread was made 50 per inch instead of 40, and the subdivisions 20 instead of 25, because tenths, hundredths and thousandths as well as ten-thousandths of an inch could then be read without mental strain.

In my experience, principally in measuring sheet metal, wire, etc., I have had



A DIRECT READING MICROMETER.

about the same trouble as Mr. Moss had, and to overcome it I have constructed just such a gage. In addition to Mr. Moss' suggestions it has other good points and improvements to simplify the reading. One of these is a self-registering dial attachment to record every turn of the screw, thus making an instrument with which anyone can read the most minute measurements, and express them at will, in hundredths, thousandths or ten-thousandths of an inch immediately and without any further mental calculation.

Perhaps Mr. Moss and some other readers of the AMERICAN MACHINIST would be interested in seeing or hearing more on this subject. I therefore send you one of two styles of gages which I am making, thinking that you might deem it valuable enough to give some space in your paper.

The construction of my gages is such that a few minutes' handling by anyone accustomed to a micrometer will enable him to read and take measurements without any trouble. The gage which I send you marked No. 4 is a micrometer graduated to read thousandths of an inch. The screw has 50 threads. The dial is divided into 20 parts, each twentieth being divided again in 10 subdivisions which read ten-thousandths (.0001) of an inch. I believe this tool embodies every point which Mr. Moss proposes, except that its capacity is only ¼ inch. However, in addition it has a self-registering indicating dial, which records every turn of the screw and makes it practically direct reading: Open the gage to 140. It then reads 140/1,000 inch, 14/100 inch, or 1,400/10,000 (0.140) inch. Again turn the pointer to 143½. It then reads 143½/1,000 inch, or 1,435/10,000 (0.1435) inch. Any measurement on which the pointer stops after the tenth subdivision, in reading direct, you always read 10 more than what the registering dial shows; for instance, if the pointer in measuring stops at 15 and the registering dial shows 140, you read 155/1,000 inch, or 1,550/10,000 (0.155) inch.

The other gage which I make is generally used by jewelers and silversmiths to measure plate stock, wire, etc. It reads in 4,000ths (0.00025) of an inch only. The screw has 40 threads and subdivisions are 100, one turn of the screw registering 100/4,000 (.025) inch, two turns 200/4,000 (.050) inch, etc., thus simplifying the reading still more than with the other gage and doing away altogether with any further calculations whatever. Furthermore, it makes very easy any translation of, for instance, the wire gage size table into easy reading figures without facing a regiment of figures to express I don't know what millionth part of an inch, as other tables have them now.

The gages can be used best by standing on table or bench, operating the screw with the right hand and the article to be measured with the left hand.

H. V. BERNHARDT.

The Metric System in the Machine Shop.

Editor American Machinist:

Having read with interest the "cos and pros" in regard to the metric system in yours and other mechanical journals, I wish to express my ideas on the subject, having had some experience in the use of the metric system in mechanical work. This subject is surely of great importance and I cannot understand why there is so little said about it. Is it because there are so few who have actually used it? The question of convenience seems to be the most vital and I do not believe that there are very many mechanics who are familiar with it that would not recommend its use. It is simple because it is a purely decimal system. But unfortunately they are not always to have their choice in such matters. Whenever questions arise involving expenditure the magnetic needle in the financial compass seems to have a tendency to point to the negative, not to remain in that position, however. We did not continue to ride on horse cars because it was expensive to generate electric current, we do not continue to use carbon tool steel because it is less costly (first cost) when-

ever the other steel shows up to better advantage, and if the metric system is really comparable with such commodities it will, I believe, fight its own battle and come out victor in the end; this may take a long time, but it will win, just as the electric current is doing now.

The electrical engineer uses the metric system very extensively, only he goes one better, for the reason above mentioned, and quite deservedly gives employment to its second cousin, the Centigrade. Is it not a fact that we are using decimals in our present system for convenience and consequently save time? There must be some advantage, or it would not be resorted to so commonly. Let us imagine, for instance (if this is possible), having one of our micrometers graduated to 32ds, 64ths, 128ths, etc. I don't believe there are many who would enjoy using it and performing such mental acrobatic feats as would be required. I fear this question is not receiving as much attention as it really should from mechanics in general, and more particularly from those who are burdened with a large amount of mental work. I hope to hear others express their views. LOUIS DELIVOUK.

Chicago.

Marking Negatives.

Editor American Machinist:

Referring to the inquiry of W. E. Morey at page 800, I believe the method adopted a few years ago by the Webster, Camp & Lane Machine Company for lettering their negatives will be of interest to him. On all of our negatives the background was stopped out, thus producing a white surface for background. In order to produce the lettering we made a stencil by taking a fresh piece of ordinary carbon paper, such as used by typewriters, putting it in the machine between two pieces of light paper, then writing the description desired so that it would read properly from the back of the carbon paper. A little practise enables the operator to so gage the stroke as to take off all of the carbon from the paper, thus producing a good, clear stencil. The film of the negative is then scraped off from enough surface to provide room for the lettering, and the carbon stencil is then gummed to the negative. This produces nice, clear, black letters on the white background, and is found very satisfactory. J. H. STRATTON.

Editor American Machinist:

Referring to the inquiry about marking negatives, at page 800, I would say that this can best be done when the negative is made. In arranging the subject for photographing for commercial purposes, the negative number or title may be neatly marked on a board with a brush or with pattern letters, using either white letters on a blackboard or the reverse, as the surroundings may determine, to give the greatest clearness. Place this board so that it will be photographed at the desired point near the edge of your negative and the trick is done. A. G. HOLMAN.

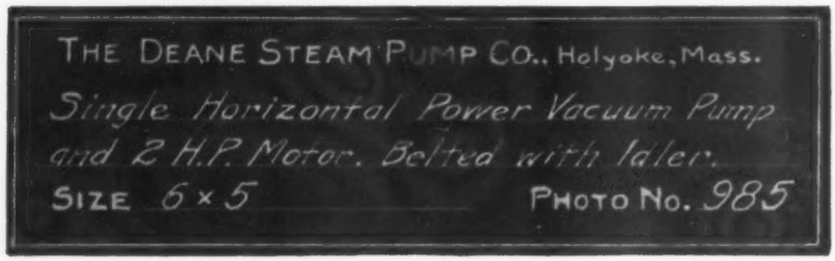
Editor American Machinist:

At page 800 Mr. W. E. Morey asks for a method of marking negatives, and I submit the following as a neat and convenient way of doing it.

The accompanying illustration is a reproduction of a print from a marked negative.

Rule off on the film side of the plate the space where the title is to go, preferably in one corner, and scrape the film away with a knife so that the glass is perfectly clear. Cut a piece of white bond paper slightly larger than the blank space on the plate. Put the title, photo number and other desired information on this slip of paper in black india ink. Paste this label on the film side of the negative with the lettering next the glass, using transparent negative varnish for an adhesive. If the negative has been painted out, a wide margin may be left on the label and the adhesive applied only to this margin. The negative may now be printed from in the usual manner.

If the plate is unusually dense and the title prints too dark, a layer of paper can be placed over the label and the color of the title regulated as desired. It will be found desirable in many cases to have labels printed and cut to size so that it is only necessary to fill in a brief description or number with drawing ink before attaching to plate. All titles will then present a uniform appearance.


THE DEANE STEAM PUMP CO., Holyoke, Mass.
Single Horizontal Power Vacuum Pump
and 2 H.P. Motor. Belted with Idler.
SIZE 6 × 5
PHOTO No. 985

REPRODUCTION OF A PRINT FROM A MARKED NEGATIVE.

In painting out a negative so that the background will print white, it is customary to use a preparation called opaque which is mixed with water to form a thick paste and is applied with a brush or old ruling pen, large blank spaces being covered with orange or black paper to prevent the passage of light. This method has given a great deal of trouble from the cracking of the opaque and the tearing of the paper necessitating frequent renewals. A superior method, which avoids this trouble, is to use the opaque simply to outline the machine photographed and to cover the background with ordinary black shellac applied with a camel's-hair brush put on thick enough so that no light will show through the plate. The shellac gives a smooth flexible coating which lasts indefinitely without cracking. Both opaque and shellac should be applied to the film side of the negative.

B. C. WOODFORD.

Standardizing Abbreviations in Technical Papers.

Editor American Machinist:

At page 719 appears an advance copy of the committee's recommendations on standard abbreviations, etc., for the "Proceedings" of technical societies and other technical work. I say "technical societies," because it is obvious that the action of the senior societies of America will form a model not only for almost all other societies in America, but, to a greater or less extent, in other countries.

I wish to take advantage of the editorial footnote and offer a few criticisms on this report, the more so as this very question of abbreviations, symbols, etc., has been worrying me not a little for some time past; and the reason for this is twofold. In the first place, you have been good enough to publish from time to time various small items I have contributed to your paper. In these I have endeavored to conform, as nearly as I could, to your style in order to reduce, if possible, the labor in preparing the copy. Whether I have succeeded or not I cannot say, but I trust my small efforts in this direction have been appreciated.

My other reason for venturing to criticise—not necessarily adversely—this report, is of much greater importance. Early last year it was reserved for one of those geniuses—Heaven bless them!—who can think of the right thing at the right time, to suggest that we in Rugby, boasting of two engineering establishments, not including the railway repair shops, should also have an engineering society, partly to beguile the tedium of the winter by "shop" talk, and partly to show the world what a progressive and important engineering center Rugby is. The winter that is now of the past saw our first series of meetings, and saw also how the enthusiasm that is born of ignorance became sobered down in the "sadder and wiser man," as evening after evening was spent in preparing copy, discussions, proof-reading, and the hundred and one—say, rather, thousand and one—things which worry the life of those who prepare "proceedings" in their spare time; for in a weak moment I had undertaken the duties

of "honorary recording secretary." Now that the sessions are over and I have reached the index, I have time to take stock of the unavoidable inconsistencies which have crept into the volume. "Unavoidable," because many points had to be settled with the printer on the spur of the moment over the 'phone.

The experience in preparing this volume of "Proceedings" has had the effect of crystallizing many points relating to the abbreviations and symbols used. For, in spite of the fact that it consists of only about 200 pages, it entailed a great amount of labor, as we held meetings every fortnight, and the speakers averaged 10.4 per paper. The results of my experience I therefore propose, with your kind permission, to give now.

In the text it is usually best to spell out and not to use abbreviations; but the example given in (1), page 719, seems to me to be unfortunate, for the reason that a distinction should be made between derived units with special names and those which may be called descriptive units. By the former are meant such units as horsepower, kilowatt, etc., and by the latter revolutions per minute, miles per hour, etc. The first should have capitals, even when spelt out, and certainly when abbreviated; thus: 10 HP, without either period or space between the letters, not 10 h. p. The English institutions adopt methods which differ from one another in some slight respect. For example, the Institution of Civil Engineers would write 10 HP, as above; the Institution of Mechanical Engineers, 10-H.P., putting a hyphen between the number and the H and a period between the H and P; the Institution of Electrical Engineers would put 10 H.P., leaving out the hyphen. "Hütte" adopts the method suggested above, viz.: 10 PS (Pferdestärken).

But this is not all, since it rarely happens that one writes of horse-power in general without stating whether the power is measured at the piston or at the shaft or at the switchboard. Here again is a want of uniformity among the English institutions. The Civil Engineers, with a correctness which can only be commended, spell the qualifying word out, thus: 10 indicated HP, using a lower-case character for the initial letter because indicated Horse Power is not a unit, the word "indicated" merely explaining that the power is measured on the piston. The other two institutions merely prefix the letter I or B or E, as the case happens; thus: 10-I.H.P. For ordinary purposes in the text the method used by the Institution of Civil Engineers certainly seems the best, and where it is used for formulas or in mathematical expressions where the words indicated, brake or electrical, are too long to spell out, a lower-case initial letter should be prefixed to the unit abbreviation, thus: 10 iHP. The method used by "Hütte" is hardly as good; here the distinguishing letter is added as a small suffix, thus: 10 PSi.

There appears even a greater divergency of opinion in the writing of what I have called descriptive units, than in the special units already referred to. To begin with, descriptive units are always spelt with lower-case characters; hence lower-case characters should be always used in abbreviations. As to exactly what these abbreviations should be and how they should be put together, is a matter which sadly requires some kind of system. Here I shall refer only to the method of writing the compound abbreviations, leaving the abbreviations themselves for the nonce. The most ingenious method of expressing descriptive units that I have come across is to be found in "Hütte." An example or two will explain. A falling body at the end of the first second has attained a velocity of 9.81 meters per second; the abbreviation would be written thus: 9.81 m/sk., which is, of course, a strictly correct way to write it. The acceleration due to gravity would be written: $g = 9.81$ m/sk^2, or, leaving out the stroke, $g = 9.81$ m sk^{-2}, leaving a narrow (or "en") space between the m and sk. Stresses are written kg/qcm., kilograms per square centimeter; Steam Consumption, Kg/PSi, kilograms of steam per indicated Horse Power. In all cases the / is used in place of the word per or letter "p." Indices are never used for expressing area or volume; thus, area is written qcm, square centimeter; volume, cbm, cubic meter, etc., and not cm^2 or m^3.

With regard to the example chosen in (3), viz.: the Heat Unit, it can safely be said that no unit has been more abused by authors, editors and printers than this one. One writer, indeed, questions whether it is a unit or not,* and adds a hit which is too good to miss, so I give it here. "The Institution of Civil Engineers has recently recommended officially that 'British thermal unit' be shortened into B. th. U., as opposed to B. T. U., which stands for 'Board of Trade Unit,' an irregular and barbarous name for 3,600 joules. No doubt British thermodynamicians are getting so efficient in manipulating their units that inaccuracies due to the interchangeable use of the British thermal and Board of Trade unit are becoming perceptible." As an Englishman, I ask why in the world has the word "British" been tacked on to this poor, despised unit? Even the Americans religiously designate it as a British unit—I wonder if in sarcasm. I will not worry you further about this point, except to remark that in my own work I use WE to stand for the amount of heat required to raise one kilogram of water through one degree Cent.; and HV for the amount required to raise one pound one degree Fahr.

The idea of placing a cipher before the decimal point (11) is good; but with regard to the decimal point itself, I distinctly prefer our English way of putting it *midway* up the figures, and it is certainly pleasing to find that so carefully edited a journal as the AMERICAN MACHINIST is in agreement with this.*

The committee's recommendation in (12) to use spaces instead of commas in pointing off thousands appears to me to be objectionable, partly for the reasons given by the secretary of the Institute of Mining Engineers (page 720), and partly because this method should be used only in tabulated work, where it is a distinct advantage to point off by means of spaces every two figures for numbers dealing with squares, and every three figures for numbers dealing with cubes, thus facilitating the use of the tables for multiples and sub-multiples of ten.

There are two or three other points relating to the editing of "Proceedings," but not dealt with by the committee, upon which I should like to remark.

(a) It is a great saving to write expressions requiring a dividing line thus R/T, instead of $\frac{R}{T}$ the latter way being most awkward to deal with in the text. Of course where mathematical expressions are used, they should be properly written and spaced.

(b) Papers and discussions should always be written in the third person, and not in the first. This is no doubt largely a matter of opinion, but to my mind a paper or discussion reads much better in the third person than it does in the first. It should be the aim of all technical writers and speakers to sink their own personality as much as possible. In England the Institutions of Civil Engineers and Mechanical Engineers adopt the third person; the Institution of Electrical Engineers adopting the first person, as also does the American Society of Mechanical Engineers.

(c) If in the discussion the remarks of any speaker are carried over on to an even-numbered or left-hand page, the speaker's name should be printed at the top in small capitals. The want of this simple expedient renders the pages of the discussions in the Proceedings of the American Society of Mechanical Engineers as awkward to refer to as a badly made index would. I sincerely hope Professor Hutton has not been troubled by the anathemas I poured on his head when studying the discussion on Mr. Halsey's paper on the metric system.

(d) An extra lead should be dropped in between the end of one speaker's remarks and the beginning of the next. This facilitates the finding of the beginning of any member's contribution to the discussion. The Institution of Mechanical Engineers allows nearly 5-16 inch.

I have far from exhausted the various

* "Entropy"—James Swinburn.

* Vol. 26, p. 1370.

points that arise in the preparation of Proceedings, but will refrain from saying more at present, and will wait to see what others say. ERNEST R. BRIGGS.

Rugby, England.

An Oval Chuck.

Editor American Machinist:

The accompanying sketches will show the essential features of a practical oval or elliptic chuck. Perhaps not all toolmakers have had much to do with oval turning or tools, but those who have had to "chop" out oval drawing punches and dies, curling tools, or any work of this nature, can more readily appreciate the value of the device here shown. All of the difficulties of this class of work are evaded by the use of an oval chuck, and the making of an oval die becomes nearly as simple as tho it were round. This oval chuck is adapted to any kind of turning that can be held in ordinary three- or four- jawed chucks, strapped on the faceplate or otherwise held, without the use of the dead center. Any of the regular lathe tools are used in connection with the work, just the same as for turning round work. The one thing absolutely necessary is that the cutting point of the tool must at all times be kept level with the lathe center. To insure this, we generally use a surface gage set on the ways of the lathe.

This chuck by its movement determines merely the difference in length between the major and the minor axes of the ellipse, the actual size of the ellipse produced, or its outside dimensions, depending entirely upon the difference from the center at which the point of the tool is set. The cutting may of course be either external or internal.

Fig. 2 is a front elevation of the oval chuck in its neutral position, and Fig. 1 is a vertical section of the same. *A* is a gray iron standard forming the base or frame of the chuck. This is secured to the front of the headstock by screws *P* and also held down by bolt *O*. In this standard *A* is mounted the dove-tailed sliding block *B*, the sliding being merely for adjustment according to the proportions of the ellipse to be produced. The lateral adjustment of this block is by the screws *a*. With the slide in the position shown in Fig. 2, the piece turned would be round, but any movement of *B* to the right of this position would make the work elliptical, the difference between the major and the minor diameters increasing with the distance to which *B* is moved to the right, and when the block *B* comes in contact with the lug at the right the limit of ellipticity is reached. The projecting part *b*, Fig. 1, of the sliding block *B* is round and upon the external round surface ride the sliding blocks *D*. Upon the lathe spindle *L* is screwed the hub and the round flanged piece *J*. The diameter of *J* is the same as that of the outside of the plates *K*, Fig. 2, which are fastened by screws on to the face of *J*, these plates not showing in the section, Fig. 1. The plates *K* hold on the sliding piece *C*, which has a dovetailed base sliding between them. The thickness of the plates *K* is a little less than that of the sliding block *C*, so that when *H*, if required, is swung around, it will clear them. *H* has a little hub which centers it in *C*, and it is held to *C* by the two bolts *I*. The thread on the hub of *H* is the same as *L* the main spindle, and it takes any chucks or face-plates that may be fitted to the lathe. The curved slots for the bolts *I* are to allow *H*, with its chuck and its piece of work mounted upon it, to be turned so that the elliptical axis of the work will coincide with the elliptical movement of the apparatus, and when this is adjusted the bolts *I* are tightened. At the back or inside of the sliding plate *C* are fastened at each end by the bolts *F* the blocks *E*. The inner faces of these blocks *E* opposite each other are flat, and against these slide the blocks *D*, the round rods *G* soldered into the faces of *E* serving as additional guides for the blocks *D*. The inner surfaces of the blocks *D* are circular and fit the round surface *b* of the eccentrically adjusted block *B*. The little screws *e* give a slight lateral adjustment to the screws *F* and through them to the blocks *E*, so that the sliding blocks *D* will have no play or lost motion while free to slide against *E* and also to turn on *b*. Fig. 3 shows *D* and *E* separately. To permit the requisite end movement of *C* the round flange of *J* is notched out at *M*, Fig. 1, sufficiently to permit the part *N*

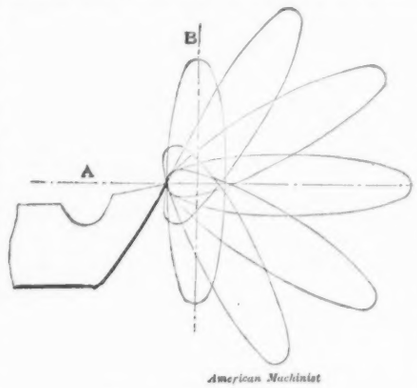


FIG. 4. OVAL TURNING.

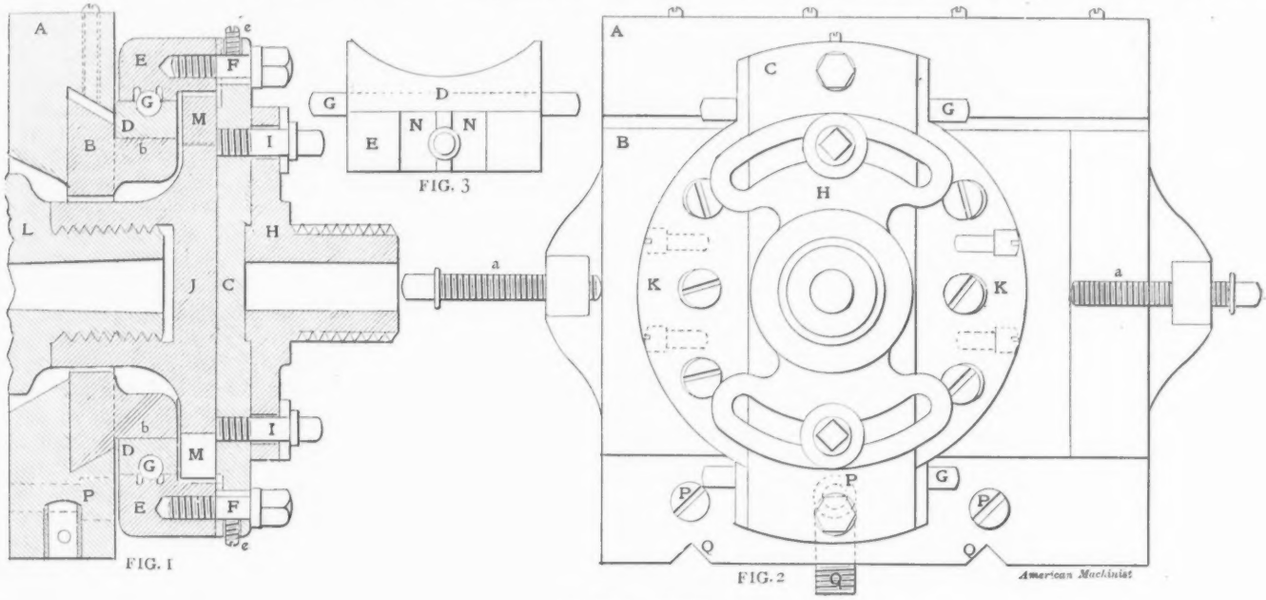


FIG. 1 FIG. 3 FIG. 2

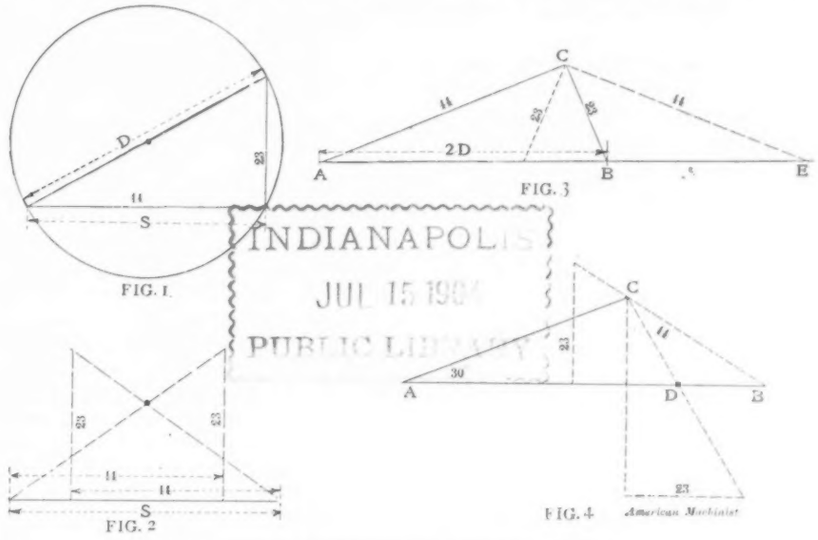
AN OVAL CHUCK.

ing parts and places where lost motion might occur, the fixture would be a frail affair; but when the parts are adjusted properly it is surprising how rigid everything is and what large and smooth cuts can be taken. U. MENDER.

A Triangle for Equivalent Geometrical Figures.

Editor American Machinist:

On page 412 you describe a triangle patented by J. C. Wiltmore, by the aid of which a square can be constructed equal in area to a given circle, etc. There is no doubt that such devices are very old, but those interested in such things will find precisely the same triangle described in *The Engineer* or *Engineering*, of London, some twenty-two years ago. My purpose, however, is not to show that Mr. Wiltmore can have no patent in the triangle described, but to point out that in one case at least a better use can be made of the instrument than he describes.



TRIANGLE FOR EQUIVALENT GEOMETRICAL FIGURES.

In the first place it should be said that the triangle can be readily constructed by drawing a right-angled triangle having a base of 44 units and a perpendicular of 23 units. Then to construct a square equal in area to a given circle: Draw the circle and place the hypothenuse of the triangle on the diameter. Then S will be the length of the required side, Fig. 1.

To construct a circle whose area shall be equal to that of a given square: Let S, Fig. 2, be the side of the given square. Apply the triangle to the two ends of S, as shown, and the intersection of the hypothenuses will give the center of the required circle. By this method it is not necessary to *construct* the square as on Mr. Wiltmore's plan.

To find a straight line equal to the circumference of a circle of diameter D: On the straight line AE set off $AB = 2D$. Apply the triangle as shown in Fig. 3 and from A draw AC and from B draw BC. Reverse the triangle and draw CE, giving AE, the required circumference. The converse problem is solved by an obvious inversion of the method just described.

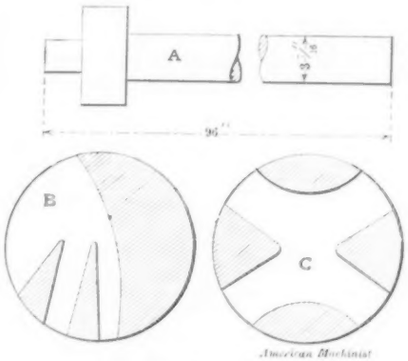
To divide a line in extreme and mean proportion is an easy matter when this triangle is available: Let AB, Fig. 4, be the line to be divided. From A draw AC at 30 degrees and, applying the triangle to the point B, obtain C. Then use the triangle again as shown, obtaining the required point D dividing the line AB in extreme and mean proportion.

There are other special triangles for simple circle squaring, etc., but the foregoing appears to cover the most practical requirements of the draftsman. M. E.

Grinders' Troubles.

Editor American Machinist:

I was much interested in "Grinders' Troubles" at page 690 and offer a few of my own experiences along this line: Some time ago we had a number of shafts to grind as at A, which were so large for the machine that they had to be ground on steady rests. After taking two or three cuts we would find the overhanging end running out 1-64 inch, and all our efforts to cure this seemed of no avail, for as fast as we would bend the shafts they would run out again as soon as we began grinding. Finally we succeeded by bending them first too far and then bending them back; after this we had no trouble.



GRINDERS' TROUBLES.

Very often when the work shows bad chatter marks, and the nature of the work will not permit back rests, the difficulty can be overcome by changing the speed of the work. We have a large quantity of Corliss valves to grind which vary in size from 3½ inches diameter by 18 inches long to 8½ inches diameter by 48 inches long, and on all these sizes, both admission and exhaust, shown in section at B and C, respectively, they will grind .001 smaller in center than at each end. I would like some reader to offer an explanation.

C. W. HENRY.

Terence Moriarity's Cold Saw.

Editor American Machinist:

At page 864 I told you about the phosphor bronze hubs. One day, in an unguarded moment, I brought a copy of the AMERICAN MACHINIST into the shop. Mr. Moriarity borrowed it, and found an article on "Modern Methods," which struck a harmonious chord in him, and forthwith the shop was beset with modern methods.

Moriarity seemed to think that any change from the old methods, either for better or worse, was "mothern mithids." I had finished with the turning of the hubs, and was making the axles for them. For this we used 5-16 and ⅜ inch cold rolled for the front and rear hubs respectively.

I measured the length and then cut through with a hack-saw (we had no hole in the lathe spindle, as I told you before, so it was impracticable to cut off in the lathe). I would then thread them with an old pair of open dies that Moriarity had brought with him from the "ould sod."

"Dixie, me maan, how long does ut taake yez to cut aff an' tread wan o' thim axles?"

"About twenty-five minutes."

"An' how long does th' cuttin' aff taake?"

"About five minutes."

"Thot's too long; phwat yez waant is mothern mithids. Me woif's cousin, Dinny, wurrks at Pincoyd, an' he do say they cut rails an' oibames an' th' loike wid a circla saa. If thim domd greenhorns an' Poles an' Oitalians kin saa oibames, Oi kin saa ⅜ stale."

So Moriarity stepped into the office and drew five dollars out of the petty cash and went out. The next day an express wagon drove up to the door and delivered an old circular saw (for wood), with teetli pitched about 2½ inches apart. The old wooden table had a slot in it about 2 inches wide, which had been worn by the wabbling of the saw.

"Dixie, me maan, drap thot job an' git thus saa put oop." So I dropped the job I was at and set to, to erect the old circular saw.

"I'm ready to put the pulleys on now,

Mr. Moriarity. What speed do you want the saw to run at?"

"Thot's th' crucible pint, Dixie. Th' shpade o' thim saas shud be no liss nor no more nor tree tousand. Me woif's cousin, Dinny, says twinty-foive hunder, but he's cuttin' big stuff. Ye know yersilf, fer Oi larned ye, af yer turnin' wan-inch stuff ye shpade yer lay up more nor af you're turnin' tree-inch." This Solomonic reasoning could not be refuted; but what the diameter of work in a lathe had to do with the diameter of a piece to be cut by a saw, I failed to see.

So I put the correct pulleys on and spun the job out till a little before 6 o'clock. The next day Dixie had an acute attack of cold-saw-fobia. On the day following, as I passed through the office, I saw Moriarity with the left side of his head bandaged up and his right arm in a sling. The topography of the shop was changed. On a spike in the wall hung the "saa," with one tooth gone and several others showing pathetic signs of (that only too common human failing) trying to bite off more than it could chew.

Over at the boiler in a heap, chopped into kindling wood, lay the saw bench, ready for the new fire on Monday morning. The bar of 3/8-inch cold rolled, where the saw struck it, made a dive into the 2-inch slot in the table; the short end (about 3 feet long) struck Moriarity on the left side of the head as he leaned over the saw bench, while the long part in his right hand brought his right arm up against the saw. Luckily the belt slipped or broke at this point, so a slight gash in Moriarity's right arm was all that resulted.

From that day on till the final cataclasm no "mothern mithids" were encouraged by the firm of Terence Moriarity & Co. DIXIE.

Improved Screw Milling Cutter Arbor.

Editor American Machinist:

The small screw arbors on the milling machine were a constant source of trouble and delay caused by the thread stripping or the thread end breaking off, and one was as bad as the other. If made of tool steel, the ends broke off; if made of machine steel, the ends bent and the cutter wabbled. But one day a new idea strayed along and the small screw arbor made on a different and a more satisfactory plan, as shown by the sketch, was adopted.

The arbors were made full size, not using a collet at all. While they are as large as the hole in the spindle the outer end is quite small—in fact, can be as small as need be.

Sketch Fig. 1 shows an arbor that is used in a hollow spindle machine and is usually removed by driving on a rod passing through the spindle.

Sketch Fig. 2 shows an arbor with a tang and which is usually removed by using a drift.

When using the ordinary screw mill on a solid thread arbor, the mill must be put on, so that when it is cutting it will tighten up, altho I have had many jobs when I would like to have been able to put the mill on wrong side out, especially if it was an angular mill. But it is almost, if not quite, impossible to keep it on and do work. I have also seen small cutters screwed up so tight by the work strain that one or more teeth would be broken off in removing the cutter; while with the arbor made as shown the cutters can be put on either side out and do work. If the spindle runs against the thread it will tighten with the work; but when the cutter is put on so the work would tend to loosen and run the cutter off, it will be necessary to set the nut and cutter extra tight. Instead of trying to remove a tight cutter in the usual way, loosen the nut at the back end. If the threads are made a fine pitch, the nut will set up and hold the cutter better than coarse threads. If the thread strips or breaks, a new rod is easily put in. I am willing to concede increased first cost, but if used much it will pay good dividends. G. SCHNEIDER.

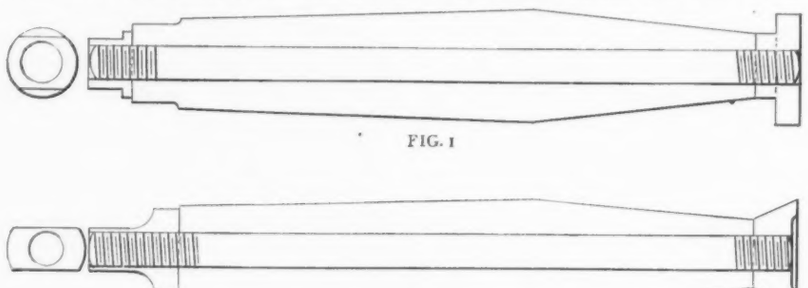


FIG. 1

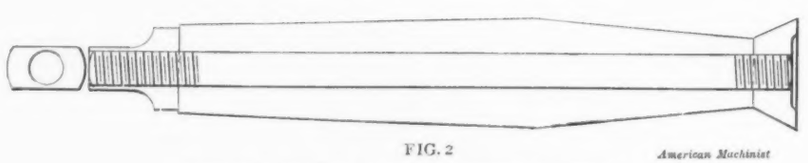


FIG. 2

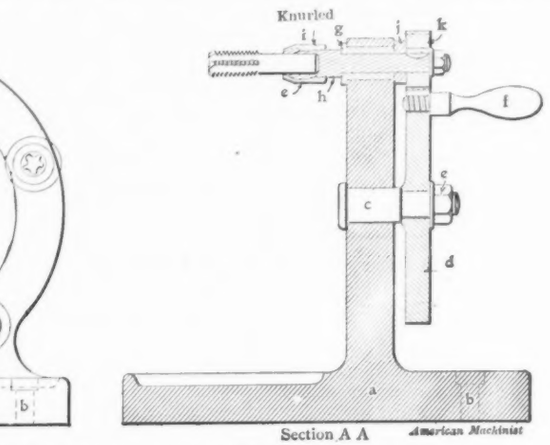
American Machinist

IMPROVED MILLING ARBOR FOR SCREW CUTTERS.

Five-Spindle Tapping Fixture.

Editor American Machinist:

The accompanying illustration shows a fixture for small work which is easily made as well as inexpensive. The gray-iron frame *a* may be placed and fastened to a bench with two screws in the holes *b*. In front it is hollowed to retain the oil when tapping. In the center a stud *c* is driven in tight; on the end of the stud the gear *d* turns against the shoulder of the stud and is held in position with a washer and nut *e*. The gear *d* is made of machinery steel with a handle *f* screwed in it. On the frame *a* are placed five spindles for tapping different sizes without changing taps for each operation. One spindle is shown in section, a bushing *g* is driven in the frame. The spindle *h* carries in its forward end a split chuck, spring tempered, which grips the tap and holds it in position when tapping, while the rear part is threaded to receive the knurled cap *i*; this tightens the spring chuck which holds the tap firmly. A ring *j* is driven on the spindle between the frame and the gear *k* to keep the gears in alinement with each other. The gear *k* is keyed on the spindle, and held securely with a washer and a nut on the end. By turning the gear *d* with the handle, the operator can feel the tension on the tap and thus be able to prevent many breakages. This fixture will drive taps up to 1/4 inch, and any number of spindles can be placed in the frame by having one spindle longer than the other, providing of course that there is room enough for the work to clear the taps which are not in use. A. L. MONRAD.



FIVE-SPINDLE TAPPING MACHINE.

Vanishing Material and Tools.

Editor American Machinist:

Many old firms point with pride to the small numbers of men on their "non-productive" staff. An old-style firm will, per-

haps, get along untrammeled by intricate systems and with half the number of clerks employed in a modern-style place of the same size. Occasionally, however, an old firm finds it necessary to institute a new system of costing, when many surprising facts are brought to light, and among them the possibility of material, tools, etc., vanishing into "thin air." Then, perhaps, they may be brought to see that another man on the non-productive list would save what may be a serious loss of material, etc.

A Midland tradition tells of two Lancashire boilers being built—presumably under a foreman's direction—in a firm's yard and shipped off to oblivion on the firm's trucks drawn by the firm's locomotive. An inquiring spirit connected with the works could afterward find absolutely no record of the work in the firm's books and could find no man on the works who would acknowledge the existence of the boilers.

Such a state of affairs is practically impossible now, but firms attempting to cost all material should look very carefully into the causes of a certain percentage of stock vanishing into thin air. Petty thefts, if general, may be a serious consideration. Files, hammers, chisels, drills, screws, nails, wire, sheet metal, and so on, may be eaten up as much as 50 per cent. faster than necessary. The obvious cure for this is to cause everything to be properly accounted for, a thing which is still very frequently left undone where the staff is small.

Again, apart from faulty castings, wasters find their way from the machine shop into the cupola, a convenient river, or into holes and corners in a way that would astonish the directors of a firm who have to pay for them. Yet it is pretty sure to occur where there are apprentices, and it would not occur so frequently were they prevented from helping themselves to new castings or forgings to replace the spoiled ones.

A clerk's wage is usually so small that a man, who may be called a storekeeper's assistant, by keeping proper order and receipt books or papers for all material and tools used will effect a considerable saving and will also be enabled to discover the causes of the mysterious vanishing of material and tools. R. D. S.

Birmingham, Eng.

Steel Salesmen's Stories.

Editor American Machinist:

In these days when every shop manager or superintendent who lays any claim to being up to date and abreast of the times has experimented with all the high-speed steels on the market and knows the relative advantages of each, and the adaptability of each to his special class of work, and just what he can get out of them under the existing shop conditions, it is exasperating to have a steel salesman tell him he could do one-third better with his (the salesman's) brand of steel than with any other, and should be getting 50 per cent. better results.

A representative of one of the well-known high-speed steels came into the shop one day not long ago and gave me the usual "song and dance" about how superior his especial brand was to any other and how insignificant our results were to what they might be by using his steel. Now, it happened we were using his steel on some work, but I did not let him know this until he had had his say. When he started to take his sample tool out of his bag, I said "Wait a minute," and sent to the supply room for a new bar of his steel. When it came I said, "There is your steel; have it forged and dressed to suit yourself, then show me." Well, the result was he could not substantiate either of his claims, and he had to admit there was no apparent difference in the results obtained between his steel and another well-known make when tried side by side.

At another time a salesman came in, gave the same kind of a talk and asked permission to take the sample tool he had with him to the forge room, and, after treating it, show what he could do with it. This I readily granted, but while he was gone had another piece of steel of the same size, but of another brand, gotten ready and put in the lathe where I intended to let him demonstrate, with instructions to the lathe man to "give her all she'll stand." The result was entirely different from what I expected. I thought he would at least make some kind of a show; but he did not. After taking the speed, feed and depth of cut, he excused himself on some pretext and left in such a hurry he forgot his sample tool. This he came back for later, when I was away from the shop, and I did not see him again.

Now, what I have been wondering is: Does this happen in other shops, and how long is it going to take salesmen to learn not to make statements they cannot back up? J. F. M.

Table of Squares Obtainable From Round Stock.

Editor American Machinist:

Enclosed please find table of squares, which I compiled. This table will be found of especial value to milling machine and shaper hands. ROBT. A. LACHMANN.

Chicago, Ill.

TABLE OF SQUARES

SHOWING SIZES OF LARGEST SQUARES (CORNERS BEING SHARP) WHICH CAN BE OBTAINED FROM ROUND STOCK

Diameter of Stock	Decimal Equivalent	Diameter	Diameter of Stock	Decimal Equivalent	Diameter	Diameter of Stock	Decimal Equivalent	Diameter
1/8	.125	.0883 +	1 1/16	1.0625	1.7551 +	2	2.000	1.414
3/16	.1875	.1325 +	1 1/8	1.125	.7953 +	2 1/16	2.0625	1.4581 +
1/4	.250	.1767 +	1 3/16	1.1875	.8395 +	2 1/8	2.125	1.5023 +
5/16	.3125	.2209 +	1 1/4	1.250	.8837 +	2 3/16	2.1875	1.5465 +
3/8	.375	.2651 +	1 5/16	1.3125	.9279 +	2 1/4	2.250	1.5907 +
7/16	.4375	.3093 +	1 3/8	1.375	.9721 +	2 5/16	2.3125	1.6349 +
1/2	.500	.3535	1 7/16	1.4375	1.0163 +	2 3/8	2.375	1.6791 +
9/16	.5625	.3976 +	1 1/2	1.500	1.0605	2 7/16	2.4375	1.7233 +
5/8	.625	.4418 +	1 9/16	1.5625	1.1046 +	2 1/2	2.500	1.7675
11/16	.6875	.4860 +	1 5/8	1.625	1.1488 +	2 9/16	2.5625	1.8116 +
3/4	.750	.5302 +	1 11/16	1.6875	1.1930 +	2 5/8	2.625	1.8558 +
13/16	.8125	.5744 +	1 3/4	1.750	1.2372 +	2 11/16	2.6875	1.9000 +
7/8	.875	.6186 +	1 13/16	1.8125	1.2814 +	2 3/4	2.750	1.9442 +
15/16	.9375	.6628 +	1 7/8	1.875	1.3256 +	2 13/16	2.8125	1.9884 +
1	1.000	.707	1 15/16	1.9375	1.3698 +	2 7/8	2.875	2.0326 +
						2 15/16	2.9375	2.0768 +
						3	3.000	2.121

RULE

Multiply Diameter of Stock by the Constant .707

Example 3/4" = .750 x .707 = .53025

Compiled by Robt. A. Lachmann, Chicago, Ill.

Navy Yards as They Are

Editor American Machinist:

The average citizen thinks that the United States navy yards are run primarily to

supply jobs for a more or less incompetent lot of political loafers whose prodigality with the people's money is without question; that as the taxpayers' money comes easily into the coffers of the country it is likewise given the fairest possible chance to go easily through the departmental rat holes, among which are the navy yards. While this probably was the case years ago and was no doubt the origin of this unbelief in the economics of things governmental, it is, however, not the case now. In the first place all supplies are bought from the lowest bidders—altho that article which is lowest in first cost is not necessarily the cheapest. It is also true that the cost of every job is estimated before the work is begun, be it a $5 repair on a bilge pump or the building of a complete set of engines such as the Brooklyn navy yard is now building for the battleship "Connecticut"; and furthermore, one who makes the estimate is liable to get into serious trouble with the navy department should the actual cost of the work exceed the estimated outlay.

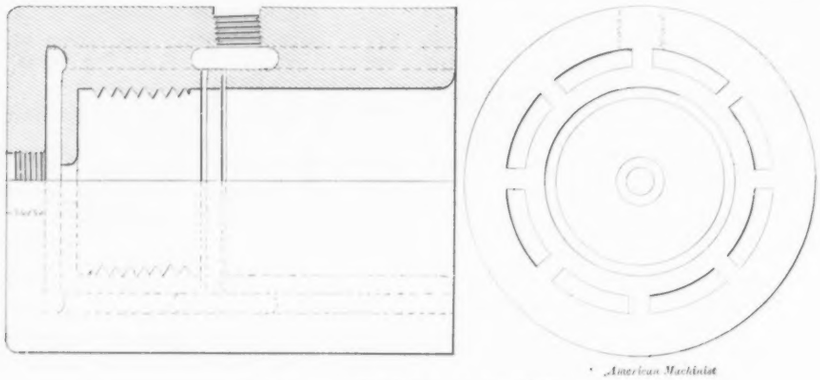


FIG. 1. THE WORK TO BE DONE.

It is not at all unusual for the different navy yards to bid against each other on jobs of considerable magnitude. The yard submitting the lowest bid, other things being equal, is awarded the contract. Furthermore, the navy yards, in order to avoid laying off valuable men, frequently make supplies, in competition with the open market. This is being done at present in the Brooklyn Navy Yard with a lot of bronze valves which would do credit to a concern specially equipped for the work.

DIXIE.

Tools for a Turret Lathe Job—Setting a Milling Cutter Central.

Editor American Machinist:

The accompanying drawings will, I hope, give a fair idea of the tools we used on a special job. Fig. 1 shows the work to be done which was, as shown, in the form of two cylinders, one inside of the other, held together by a series of webs. The cylinder was bored in the turret lathe with boring tools of the usual design which will not require any explanation; but the difficulty lay in cutting the gain at the bottom of the thread so a threaded plug holding a valve could be screwed down to the bottom of the cylinder. Then the proposition of cutting the two rings through the wall of the inside cylinder was rather a hard one, as the rings had to be a given distance from the bottom. The tool which cut the rings is shown at Fig. 2, and consists of a crucible steel body *A* with a shank to fit the turret, with a square hole mortised in it for the cutting tool *B* and a slot milled in it to allow the handle the swinging movement necessary to turn the center piece *C* about one-sixth of a complete turn. This center piece *C* is a piece of crucible steel turned to fit easily in the bore of *A*. *C* has a hardened pin in it which engages with the slot in *B*. *D* is a case-hardened screw which screws into *A* and holds the pilot bushing *E* in place. *D* has a couple of small holes in it to fit a spanner wrench made of drill rod, as shown in the front end view, Fig. 2. This tool proved to be a very effective one for the purpose. In use it was inserted into the cylinder until the pilot bushing was to the bottom of the cylinder, when a steady pull on the handle would force the cutting tools into and through the inside cylinder.

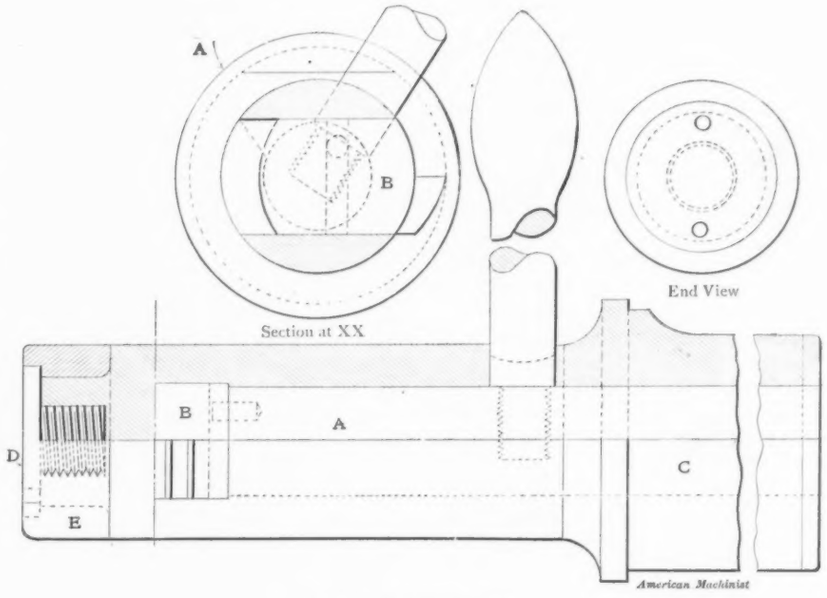


FIG. 2. GROOVING TOOL.

Fig. 3 shows a tool for cutting the gain at the bottom of the thread. This tool consists of a crucible steel body *F* with shank to fit the turret. This body is bored out eccentric from the front end to receive the shank of the cutter *G*, which is drilled and tapped to receive the handle *H*. The body *F* has a slot milled in it which is shown in the end view, and this slot is milled somewhat wider than the movement of the handle requires so that as the eccentric cutter *G* is ground off on a radial line with the center of its shank the handle may be allowed more movement in order to make the cutter cut the required depth. *I* is a case-hardened ring with a slot milled to correspond with the milled slot in *F*. *I* is used simply to regulate the depth of cut of gain tool *G*. The depth which it is necessary to cut being determined, the ring *I* is turned around until the side of its slot will act as a stop for the handle when the set-screw in *I* is tightened. On both of these tools it was found necessary to mill a flat on the body close to the cutters to form a pocket for chips.

I noticed an old milling machine hand do what struck me as a good kink the other day. He had a small job on the centers of his machine which job he had to end-mill a ¼-inch slot through, and he told me it was very essential that the slot should be in the exact center of the work. If he had had a mill something like 7-32 inch or thereabouts, he said he would prefer to put that through and then work the slot out to ¼ inch in order to get it central. As it was, ¼ inch was the smallest end mill to be had, so he put an old arbor in the spindle of the milling machine and with a lathe tool clamped to an angle-plate he turned it dead true. He next selected an arbor which he tested for truth and having satisfied himself that it was all right, placed it in the milling machine centers and with a piece of sheet

steel .002 inch thick as a "feeler," raised the table until he could just feel the arbor in the spindle and the arbor on the centers pinch the sheet steel. Then he carefully measured both arbors, found one-half the diameter of each, added them together, added the .002 inch (the thickness of the sheet steel), then raised the table .917 inch (which was the result obtained) and measuring the distance, raised the table by the use of a micrometer barrel clamped to the vertical slide. He then went to work on that slot with the assurance that his machine was properly adjusted. When done the slot was only .00025 inch off center. UNCLE JOSH.

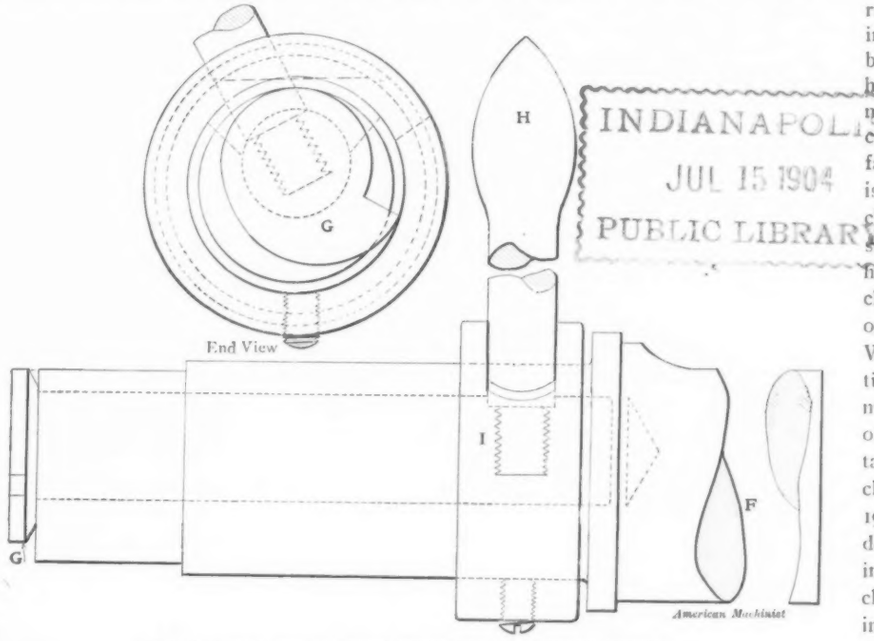


FIG. 3. TOOL FOR CUTTING GROOVE AT BOTTOM OF THREAD.

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JUL 15 1904
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the under side to fit the recess at the center of the face-plate or table. A section of the fixture at *A* is shown. We found it profitable to make fixtures for several sizes of pulleys. By doing this we were able to grip the pulley arm near the rim, and the cost of fixture is low enough to allow each size to have its own. BECK.

Chucks for Flywheels and Pulleys.

Editor American Machinist:

These work-holders or chucks shown by the sketches are good to hold pulleys, flywheels, gear blanks, etc. When running a machine I obtained good results from their use.

The heavier fixture, Fig. 1, holds a flywheel, the wheel being broken away to show the construction. We always go for a three-point bearing, whether planing a bed or turning a flywheel, and we here get a three-point grip upon each flywheel arm, and to spring the work is among the impossibilities. The usual pulley or flywheel is a six-arm affair, and this makes a three-arm grip allowable and convenient. The fixtures are equally good either upon lathe or boring mill. We have known flywheels 10 feet diameter to be held by these holders while being machined, and the quality of the work as well as the time was very satisfactory. The elevation of the work from the table by the holders allows the entire turning and boring to be completed at the one setting. The smaller fixture, Fig. 2, is a one-piece affair, a three-armed spider being cast with a projection on

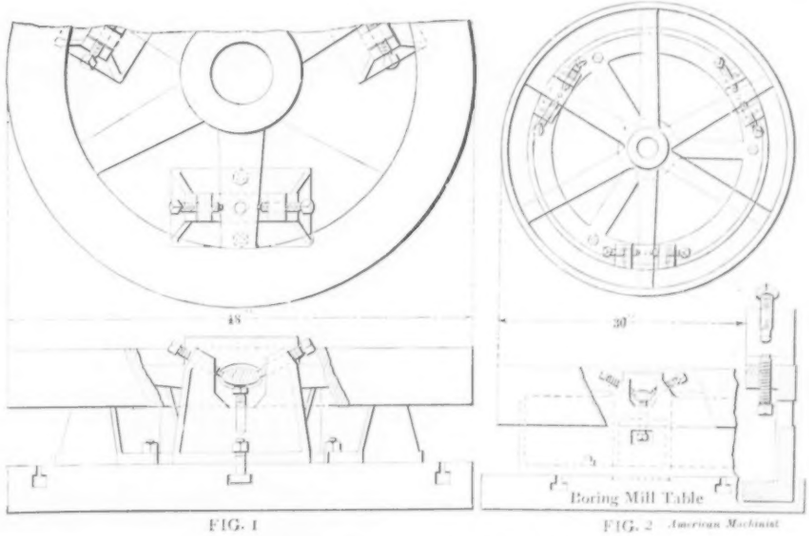

FIG. 1 FIG. 2 American Machinist

PULLEY AND FLYWHEEL CHUCKS.

According to press despatches of June 25, a court commissioner in Milwaukee issued an injunction restraining employing tailors from hiring any others than union men, the order to stand until further action by the court. We are not informed as to the basis of this injunction order, no particulars being given in the press dispatches, but certainly such an order is an innovation, and, as it stands, seems to indicate clearly enough that if government is to be by injunctions some queer results may be looked for.

German Machine-Tool Business.

The following interesting account of the present condition of the machine-tool industry in Germany is from Joseph J. Langer, United States consul at Solingen, Germany: Tool-machinery prices have not recovered from the pressure of surplus offers, so that factories have been run, not only without profit, but in many instances at a loss, although they have been somewhat busier of late. Prices have not gone up, because large stocks of machines are still on hand, and American competition is keenly felt, owing to the fact that, as is claimed, the United States is placing its surplus output of tool machines upon foreign markets. The Russian-Japanese war does not appear to have affected the manufacture of tool machinery, except that it has brought some orders for war purposes from Japan. While the matter of forming a combination is still being discussed among tool machine manufacturers for a better unity of action, no definite steps have been taken. The trade balance for tool machinery decreased nearly 1,100 tons in 1903, of which 600 tons were due to a decreased export and the other 500 to the increased import of American tool machines. For the first quarter of 1904 the import increased from 576 tons to 1,070 tons; that is, to a considerably greater extent than the exports, which increased from 5,555 tons to 6,279 tons. This is about six times the amount of the imports, while last year the exports were nine times as much as the imports. The imports from the United States have more than doubled during the first three months of 1904, being 578 tons, against 269 tons in 1903; appearances tend toward a still higher increase. This seems to be the chief reason for the continued agitation of German tool-machine factories for higher rates of duty.

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The War Against Catalog Houses.

A contemporary is devoting considerable space to the war that is being inaugurated by the hardware retailers and jobbers upon what are known as "catalog houses, *i. e.*, merchandising establishments which, by buying in large quantities direct from the manufacturer and selling close by means of widely distributed catalogs, do a large cash mail-order business at prices which retail hardware dealers, buying through jobbers, usually on credit and selling also on credit, find it difficult to meet and are therefore feeling the competition of. The matter has been under discussion for some time in "the trade" and finally a conference was held in St. Louis about it and there was a committee report adopted which, tho couched in very guarded language, means simply that the associations of hardware dealers believe that the hardware trade belongs to them; that their present methods are practically perfect; that no one should attempt to handle hardware by any other method; that if anyone does attempt it he is to be treated as a common enemy and the manufacturers who supply such people are to be boycotted.

Now of course the fact is that the catalog houses can succeed only to the degree that their methods are based upon economic laws. That is to say, to the extent that they can by their methods reduce the cost of merchandising and place goods in the hands of the consumer at less increase of cost above manufacturing costs than is possible by other methods. For years manufacturing costs have been reduced until they are now in most cases only a small fraction of what they formerly were. Manufacturers have simply been compelled by competition to constantly struggle to reduce their costs. There has been nothing like a proportionate reduction in the cost of handling these goods on their way between the manufacturers and the consumers. The catalog house is nothing more than an effort to make some reduction there, and it can succeed only by making such a reduction and putting goods in the hands of consumers at lower prices than are possible by present methods. If they are able to do this, it will be a good thing for both manufacturer and consumer. True, the jobbers and retailers may have to change their methods or find other lines of business; but if so, then that is only what manufacturers and their employees have been doing right along for years, and when they have occasionally complained of it they have been told that such was the inevitable accompaniment of progress and that there was no use in kicking against the pricks.

We believe that no one is justified in attempting to prevent or restrict the full use of improved machinery, but this is as true of commercial machinery as of machinists' machinery. What is sauce for the goose is sauce for the gander, and no one who takes part in such a war as the hardware jobbers and retailers now propose to carry on against catalog houses or who rails at department stores can consistently say a word against misguided workmen who object to, or try to prevent, the full use of labor-saving machinery. The principle is precisely the same in both cases and always wrong.

The Moral Effect of a Machine.

In a certain factory not far from New York a machine is to be seen standing idle—which, in fact, almost never does any work and yet performs an important office. This factory buys many tons of gray iron castings which have to be worked in the factory in various ways. Formerly these castings came in all sorts of ways with regard to hardness. Some of them were so hard as to be practically unworkable, and when complaint was made of this there were all sorts of excuses and chemical analyses were given to show that the iron ought to be all right. The machine in question makes an autographic record which indicates just how hard a casting is. After it was installed these autographs made by the castings themselves were shown to those who made the castings, and it was explained to them that no analyses or statements regarding the composition of iron would do. The castings simply told their own story and in their own way, and that story would be accepted, and all castings that were above a certain degree of hardness would surely be returned. The presence of the machine is now all that is necessary and the castings come all right; those who work them and pay for them don't care what their chemical constitution is, they simply want them to be workable and otherwise to possess such physical qualities as will enable them to answer their purpose.

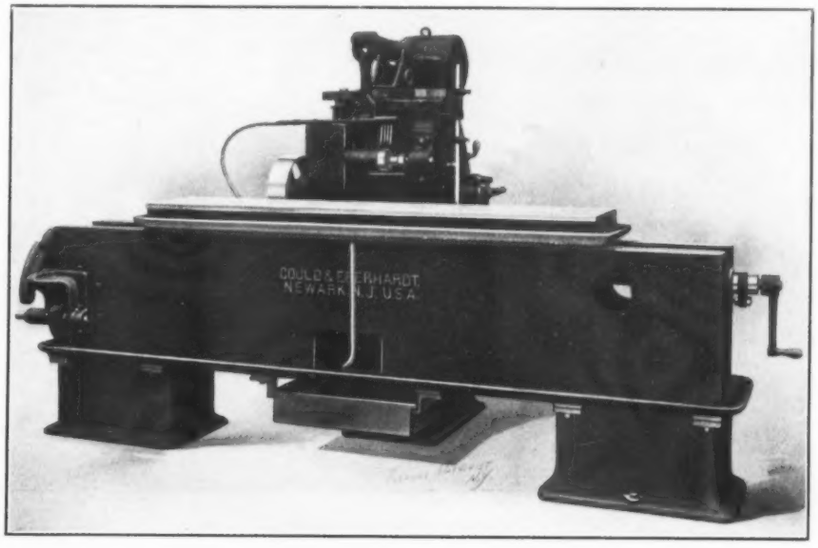
Some time ago we printed a little paragraph embodying some statements of Professor Tait about the compressibility of water. In our columns the familiar name of the eminent scientist was printed *Toit*, and now this same Professor *Toit* is having his innings in the columns of our esteemed and enterprising contemporaries. In glancing over our exchanges we have already encountered him half a dozen times. This slip of a letter makes an identifier of the most satisfactory kind.

The size of the *Railroad Gazette* has been changed from 15½x11 inches to 13x 9¾ inches, and everybody is naturally asking why it was not made standard size, 12x9 inches. For convenience of filing with its natural associates its present size is not a bit better than its former one. It seems to us that a chance to secure a positive advantage and to set a good example has been deliberately thrown away.

Some New Things.

RACK CUTTING MACHINE.

The illustrations show front and rear views of a new 6-foot by 8-inch, light pattern, full automatic rack cutting machine. It will cut racks of either circular or diametral pitch, as coarse as 3 pitch, but



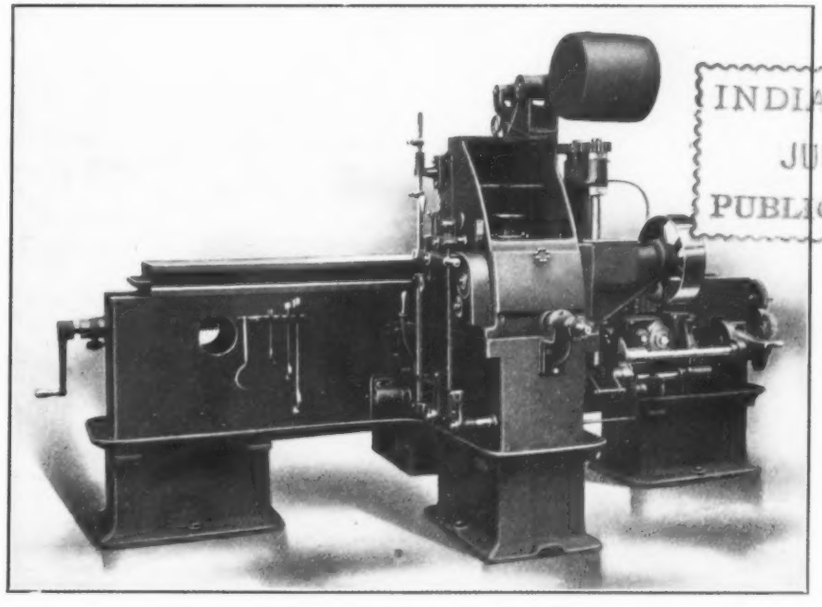
RACK CUTTING MACHINE. FRONT VIEW.

is intended for light work, such as printing-press racks, notching scale beams, etc., where great accuracy is required. The machine can also be arranged for metric divisions if desired. The spacing can be started from either end, so that it is not essential to run the table back after each length has been cut, it being necessary merely to reverse the spacing mechanism.

The rack blanks are held in a vertical position, and the cutter slide travels vertically, forcing the work down against the table, the feed mechanism is so arranged that it cannot possibly start its movement until all previous movements have been completed. A funnel-shaped opening under the cutter returns the chips and oil to the strainer in the bed. A large rim round the bed prevents oil and chips from falling upon the floor.

There are several changes of feeds; the quick-return, however, remains constant, it not being affected by any change in the feed. Racks of any length may be cut by reclamping the blanks. By a simple arrangement the screw and table can both be adjusted lengthways in the bed, so that should the setting of the racks not be correct, they can be adjusted to position lengthways after they are clamped to the table.

The table stops automatically at each end of its travel. The light-pattern machine is made in 4, 6 and 8-foot lengths, and is built by Gould & Eberhardt, Newark, N. J.



RACK CUTTING MACHINE. REAR VIEW.

A SPEED VARIATOR.

The illustrations show a speed changing device applicable to machine tools. The main shaft *A*, Fig. 2, is driven by means of a friction clutch pulley *B*. On the shaft *A* are mounted three pairs of spur gears *C D E*. The pair *C* is secured to the shaft *A* while the pairs *D* and *E* are each a running fit on a sleeve on the shaft *A*. On a second shaft *F* are the two pairs of spur

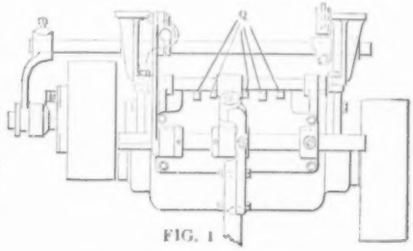


FIG. 1

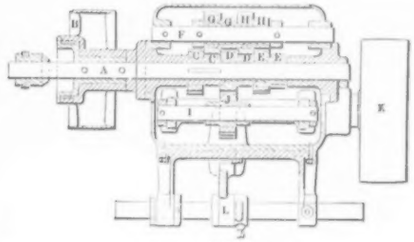


FIG. 2

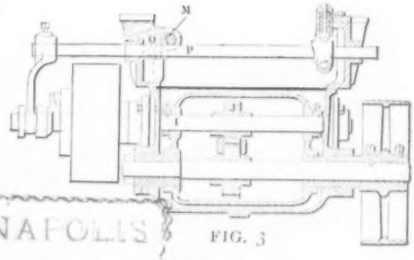


FIG. 3

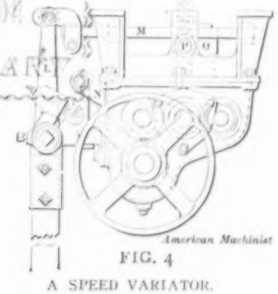


FIG. 4

A SPEED VARIATOR.

gears *G* and *H*. On a third shaft *I* is mounted a single spur gear *J* which is free to slide to and fro on the shaft *I*. The shaft *I* is mounted in a tumbler frame which swivels about a center line coincident with the shaft carrying the driven pulley, which also carries a spur gear that is always in mesh with spur gear *J* and is free to slide upon the driven shaft and drives it by means of a spline and feather. The tumbler gear *J* is slid on the shaft *I* by means of the shifter *L*.

It will be easily understood that the speed of the gears decreases the further

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they are from the fixed gear *C* on the shaft *A*. For instance. if tumbler gear *J* is meshed with the small gear of the pair *C* its speed will be less than if meshed with the large gear of pair *C*. If meshed with large one of pair *D*, then the speed from the large gear *C* is lowered by transmission through small gear of *C* into large gear of *G* and from the small gear of *G* into the large gear of *D*. The speeds as arranged are in geometrical progression from 280 turns per minute to 28 per minute. The upper part of the shifter *L*, Fig. 4, is pivoted to the toothed rack *M*, when the shifter is pulled at right angles to the main shaft the upper part moves this, which engages with the gear wheel *O*, which in turn reciprocates the toothed bar *P*, which actuates the opening and closing mechanism of the friction clutch, see Fig. 3. The member *N* of the shifting device operates the tumbler gear. At the top of the front plate, Fig. 1, there are six milled notches *Q* which correspond in center distances with the face center distances of the variable-speed gears. These notches act as locators for the tumbler gear and also gage the depth to which the tumbler gear engages with the variable gears. This speed variator is manufactured by Roos & Mill, 2010-2012 Central avenue, Cincinnati, Ohio.

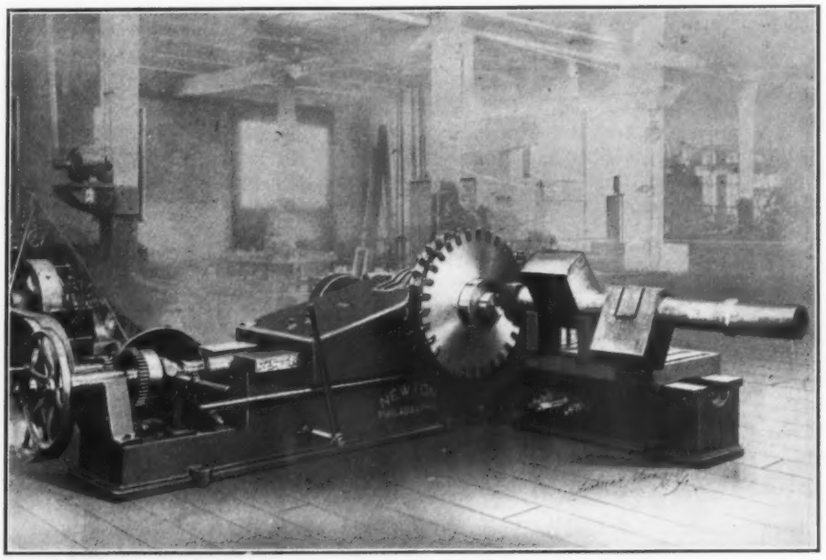
CRANKSHAFT COLD SAW CUTTING-OFF MACHINE.

The illustrations show front and rear views of a new cold saw cutting-off machine, in which the saw spindle is extended so that it can carry two saws, thus making it capable of taking both cuts in a crankshaft web simultaneously. To accommodate the various widths of crank throats, the spindle is fitted with a number of spacing collars of different widths. The blades are keyed on the spindles in addition to the four driving pins shown in illustration, which pass through both saws and through the collars.

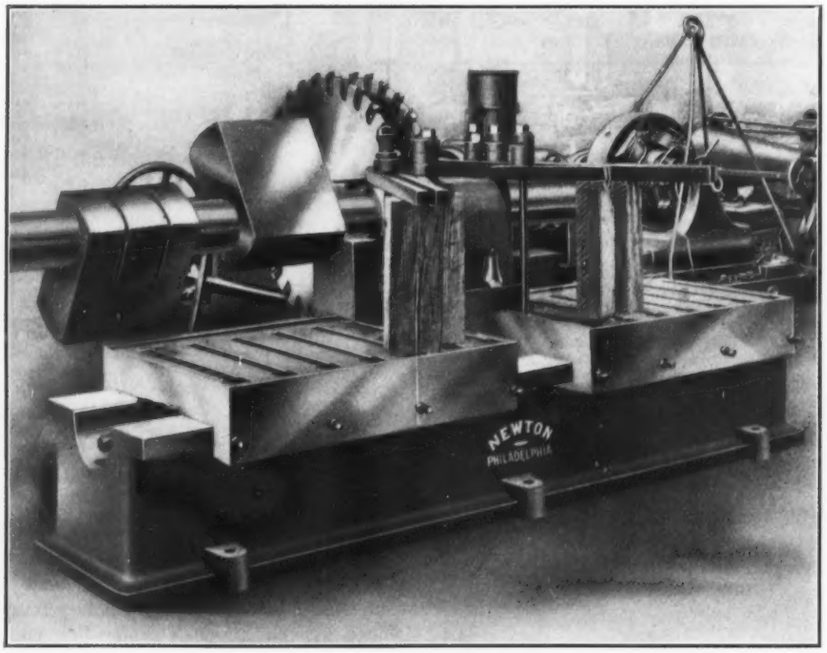
The spindle is driven through gearing by a phosphor-bronze worm-wheel and hardened steel worm of steep lead.

The saw carriage has variable automatic feed by means of friction disk and power quick return; both of these movements have an automatic throwout. The work tables are arranged so that if the machine is used with only one saw, both cuts can be made without unclamping the work. When one blade is used the crank is set on the V-blocks and the carriages adjusted the proper width apart. The crank is then clamped, and after the first cut is made the tables are moved across the bed simultaneously, by means of the idler and slip gears shown in the illustration.

The machine carries either one or two blades, 36 inches diameter, which cut to a depth of 11½ inches. Machine can also be used for cutting off round or square stock up to this capacity.



CRANKSHAFT COLD SAW CUTTING-OFF MACHINE.



CRANKSHAFT COLD SAW CUTTING-OFF MACHINE.

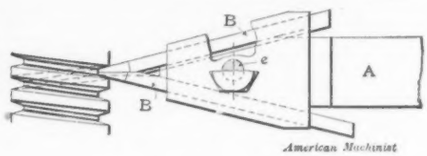
The crankshaft shown in illustrations was used for testing the machine previous to shipment. The machine was merely set on blocks and wedged up, being held in position by its weight only.

The web of the crank is 8¼ inches wide. The blades of the Taylor-Newbold saws, which are 9-16 inch thick, were set 5¾ inches apart. The depth of cut was 5⅝ inches; the peripheral cutting speed of saws, 55 feet per minute; time required to make cuts, 17½ minutes. The stock used in this crank was exceptionally hard forged steel about .47 carbon.

This machine is built by the Newton Machine Tool Works, Philadelphia, Pa.

A THREAD CUTTING TOOL.

The illustration shows a thread cutting tool especially designed for Acme and worm or other coarse threads. The holder *A* at the front end is shaped to the included angle of the thread it is desired to cut. The front end has a clamp both top and bottom held in position by a bolt *e* passing through both clamps and the front end of the holder *A*. Between these clamps are held the two thread cutting tools *B*. It will be seen by looking at the illustration how easy it is to grind the two blades so

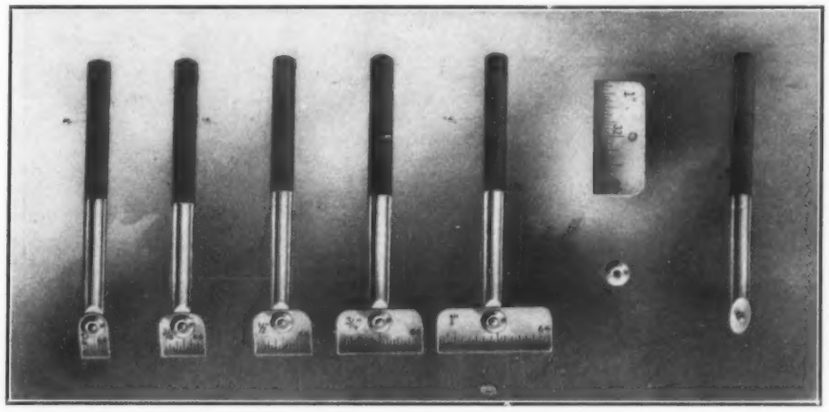


A THREAD CUTTING TOOL.

as to give any desired shearing cut to both sides of the thread. This tool was invented by John Goetz, 100 Lincoln avenue, Milwaukee, Wis., and has been tested by him during a period of six months at the Kempsmith Manufacturing Company's works.

STEEL RULES WITH HANDLES.

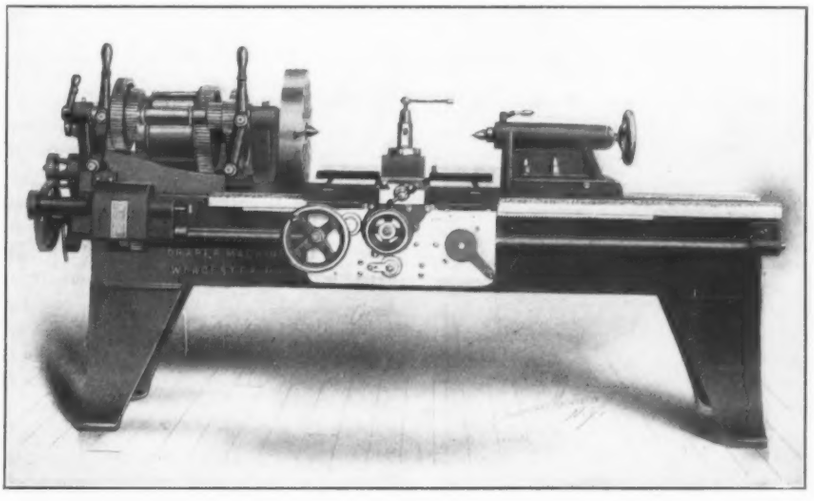
These handy little rules need hardly any description. The knurled handle is of steel, milled to an angle of 30 degrees, with a small teat left in the center of the milled part. A hole in the rule goes over this teat, and after placing a small steel spring-washer on the teat above the rule, the end of the teat is riveted over, the spring-washer retaining the rule in any desired position by friction. They can be used in any place where a rule with end graduations can, and by placing at an angle in many places where such a rule cannot be used. They are made in different sets and graduations. The rules are tempered and ground to lengths designated on them. They are made by W. E. Severence, Revere, Mass.



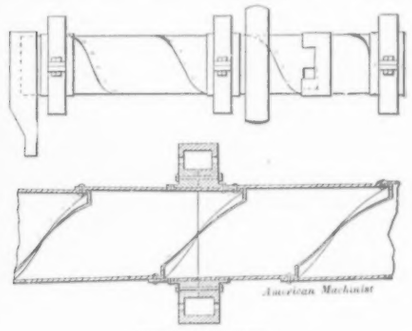
STEEL RULES WITH HANDLES.

18-INCH DRAPER REDUCTION LATHE.

The illustration shows the 18-inch Draper reduction lathe. This lathe is of an entirely new design throughout and is intended to stand up to severe duty and procure the full efficiency of the high-speed tool steels. The head is provided with a single wide face pulley to be driven by a 6-inch double belt. There are four changes of back gears operated by the upright levers shown. This arrangement gives five changes of speed in the head, which, with two large friction pulleys on the countershaft, give the correct cutting speeds for ten diameters, from one inch to six inches, inclusive. The spindle is made of hammered crucible steel with 1¼-inch hole. It runs in bronze boxes, round seated. The tail spindle is of large diameter. The carriage has long bearing on the ways; it is furnished with a plain block rest with an extra large tool-post for 1½x¾-inch tool steel. The apron is of box form, giving all shafts having severe duty, bearings at each end. The inner bearing of the rack gear is bolted to the carriage at the point where it engages the rack. The gearing in the apron is of wide face and coarse pitch, and all pinion gears are of steel, bronze bushed. The feed mechanism is so constructed that the operation of either feed locks out all other feeds, and screw cutting. The feed is from a splined lead screw, the thread of the screw being used for screw cutting only. The cross and carriage feeds are operated by the same friction. The reverse for the turning feeds is provided in the apron. Three feeds, or three screw pitches, can be obtained without change of gears, by a sliding key in connection with a nest of gears on the lead screw. The bed is of box pattern. The countershaft is provided with a third friction pulley for reversing when screw cutting. These pulleys are self-oiling, as are also the boxes. Taper attachment can be furnished if so ordered. This lathe, with 8-foot bed, takes 4 feet between centers. The reduction lathes are also made 22 and 24 inches swing. They are manufactured by the Draper Machine Tool Company, Worcester, Mass.



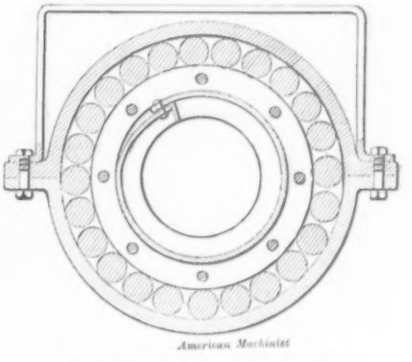
18-INCH DRAPER REDUCTION LATHE.



THE CONVEYOR.

A CONVEYOR.

The illustrations show a conveyor invented by James M. Edwards, 211 Sherman street, Morris Park, L. I., N. Y. The invention consists of a spiral or helix fastened or formed inside the cylindrical casing and rotating with it. These casings are made in convenient lengths, and are coupled together by means of flanged couplings which rotate in ball or roller bearings. These bearings may be either set upon the floor or suspended from hangers.



THE BEARING FOR THE CONVEYOR.

Owing to the fact that the helix rotates with the outer casing (and not as a separate member driven from either end rotating within a fixed cylinder, as is usually the case) these conveyors may be made of any length, and auxiliary drives may be attached on the outside of the rotating casing at any points desired.

AN OIL GROOVE CUTTING MACHINE.

Fig. 1 shows a view of the complete machine with the vise for clamping the boxes, assembled. Fig. 2 shows a view of the machine with one of the upper members or jaws of the vise removed. This jaw is seen lying on the floor at the right, next to the small square pieces. With this part taken off the cutter head is exposed to view and a half box is to be seen in position in the vise, ready to be grooved. By means of the crank, Fig. 1, the square ram in the rear bearing is reciprocated backward and forward. The round shaft in the center of the ram can be made to cut a straight oil groove, or a spiral groove may be cut, by throwing the change gears into mesh. These change gears are mounted on a quadrant, see Fig. 2. The cutting tool works in the same way as a shaper tool and is withdrawn by hand by means of the ball handle seen at the back end of the square ram. A micrometer feed and adjustable stop are fitted to the machine. Each machine has two cutter heads for the largest and smallest boxes within its capacity. The cutters are made of round steel, have lines for setting to depth and angle, and can be sharpened without changing their form. Radial lines are marked on the cutter heads for setting the tools to the correct angles. Fig. 3 shows two styles of boxes and grooves. These machines are built in two sizes by the Garvin Machine Company, Spring and Varick streets, New York.

Quick-horseless-open-ordinary-road-running-petroleum-carriage is the English of the Dutch automobile.

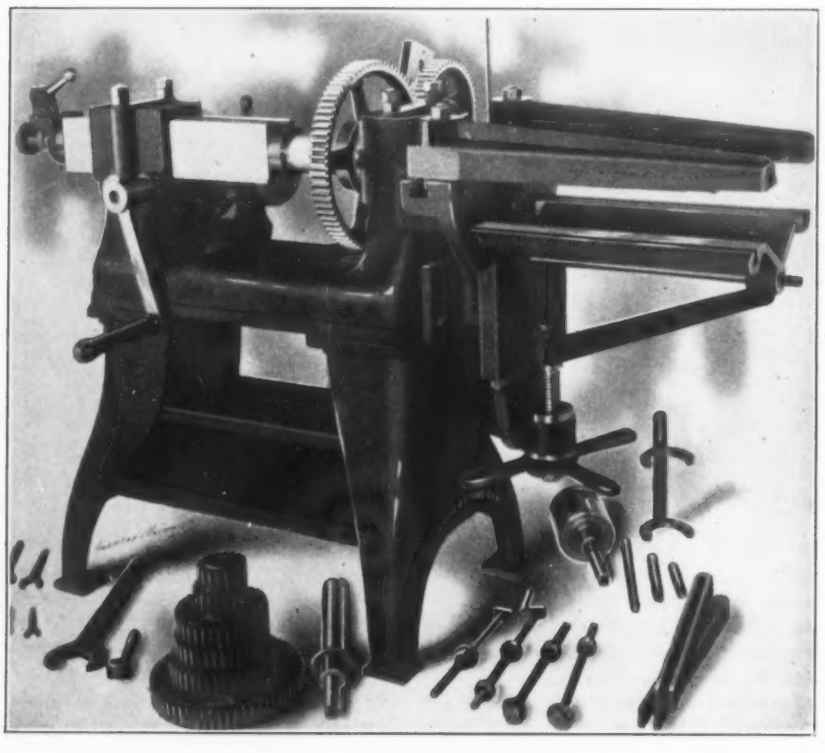


FIG. 1. OIL GROOVE CUTTING MACHINE.

Effect of the War Upon Russian Business.

At page 867 was published a communication received by the Department of Commerce from Japan, to the effect that business in that country is proceeding pretty much as if there were no unusual crisis in the nation's life. It is suggestive to peruse in that connection the following article translated in abstract from a French and Belgian financial paper, the *Moniteur Industriel*.

The ministers, the dignitaries, asserted that nothing in the current life of the nation would be changed; that the available land and sea forces were fully sufficient to inflict a memorable lesson on the presumptuous aggressor. From a financial point of view, the treasury was abundantly provided with metal specie to defray the expenses of the war, should it last a year or even longer, without recourse to foreign credit. Moreover, explained M. Kokotzef, minster of finance, the war would not cost anything to the country, since the transportation expenses were to be counted to the credit of the government, which owns the railroads and the expenditures for material were to be paid to national manufacturers. It would rather help to enhance the benefits of Russian establishments and to augment the well-being of Russian workmen. Even the Russian peasants, hitherto so unfortunate, would have their share in this blessing, tho their harvests might be poor, for the maintenance of the troops and their horses would advance prices and these good peasants would sell their produce dearer.

The requirements of this war were not going to be extraordinary, and this was rather regrettable, since there was hope that it would afford a powerful relief from the industrial crisis of the last few years.

But results haven't all turned out in

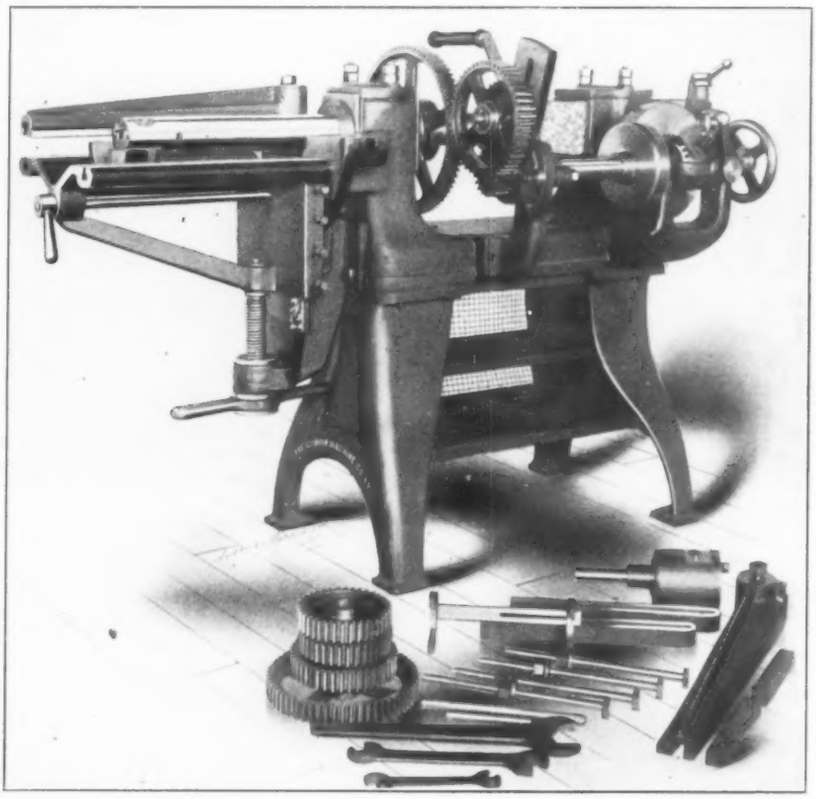


FIG. 2. OIL GROOVE CUTTING MACHINE, SHOWING CUTTER BAR AND CHANGE GEARS.

just that way. It is necessary to recede somewhat from the beautiful optimism of the first hour. At the start, the monopoly of the railway for military service suddenly arrested all commercial operations in Siberia. Immediately the reaction was felt in the Moscow district, whose industry draws a great part of its raw materials from Siberia. The stoppage of business deprived of their resources numerous artisans and establishments having a small and medium trade, which have had to lay off their workmen and other employees. The monetary obligations falling due have not been satisfied, which has compelled the banks to restrain or suppress credits.

In the Muscovite region the evil has gained more and more. The small buyer being out of work, the manufacturers are unable to unload their stocks; they, also, find themselves moneyless in the face of their obligations. The results are protests, failures, encumbrance of the offices of lawyers with legal documents and encumbrance of the pavements with workmen out of a job.

Poland, the great industrial center of Russia, has immediately, and very keenly, felt the effects of the crisis. The Polish shops maintained important business relations with Siberia and sent their products into Germany with long credits. The interruption of communications and of exchanges, the supervisions of payments of Siberian correspondents, who are large buyers from the Polish manufacturers, have thrown the latter into serious straits. The banks having need of their capital for military supplies or for loans, and having become distrustful in the presence of the universal difficulties, have withheld advances to wholesale merchants who supply the retailers on credit. Here may be seen a chain of ruin and misery.

The larger and stronger industries, with considerable capital at their disposal, have still found it necessary, by reason of the decrease in consumption, to reduce the work in their shops. At Warsaw the large tanneries and shoe factories have made reductions of hours and days, while the little factories are completely closed. Owing to the high cost of provisions great activity is reported among pawn shops.

At Lodz, at Poznansk, there survive only the three great manufactures working for the army, in possesion of strong reserves and able to allow credit. Nevertheless in this locality 15,000 workers are idle; from eight to ten million rubles of supplies of cotton products are unutilized owing to the scarcity of demand.

In Lithuania, which is also an important industrial center, there has been a considerable reduction of output. Minsk, a lumber center, is no happier. Demand, new building enterprises, bank credits and payments of negotiable paper all reflect the state of affairs.

In White Russia, at Vitebsk for example, the idleness is almost complete among small artisans, such as masons, painters, carpenters and pavers. Projects fail and emigration takes place in spite of the police.

At Libau, in the Baltic region, it is the traffic in grain which suffers, and famine shows itself, ironically, to the people customarily engaged in handling breadstuffs.

At Riga the clothing business suffers the common difficulties. In the region of the Volga, at Nijni-Novgorod, Saratof, Ribinsk, Yaroslav, Astrakan, Samara, the inactivity is almost general, and in the government of Nijni, especially, the peasants working at home for the manufacturers are in hard straits. The oil manufacturers of Saratof are ruined by the fall of 12 to 15 kopeks per pud which this product has sustained.

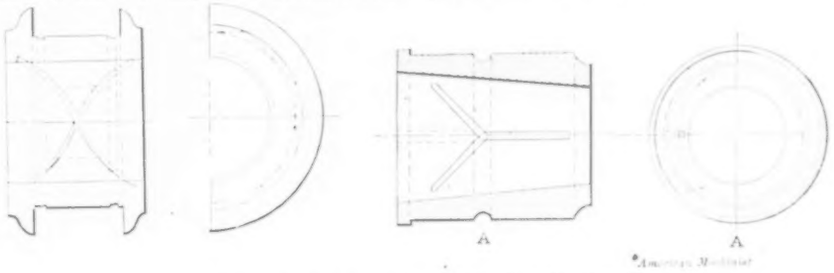


FIG. 3. TWO STYLES OF BOXES AND OIL GROOVES.

In the south, the rural industry, which ought to have been spared, has no less to complain of than the others. The market of Kief has been dull this year; there has been no business there in lands, leases or sales of the future harvest.

The basin of the Donetz has been thus far little affected, its specialties being metallurgy and coal. The large companies have had war orders to fill; yet they are menaced with insufficient help, owing to the successive calls for reserves. But in the region of Nikolaief, Kherson and Odessa a sharper crisis appears. At Odessa, an immense mart of the cereal traffic export has been suspended. This deprives of work more than 20,000 men who come every year for the loading and unloading.

The economic effects of the war extend even to the Caucasus, for the governor of Baku has been obliged to publish that there was no more work in the naphtha and petroleum plants, while at Tiflis there is complaint of arrest in the fruit trade, etc.

We cannot pursue, says the writer, this lamentable enumeration further, and we pass in silence other consequences of the crisis—wholesale death from famine and disease, robberies, pillages, attacks by armed hand, images and sad parodies of the war that is rolling on at the other end of the empire—at the other end of the world, we may say—so vast is that empire which they want to aggrandize—at the risk of tearing it apart. E. P. B.

A Flying Sledge.

The following accident, as the result of which two men may die and a third is seriously hurt, is reported from a steel works at Highbridge, near Morristown, N. J. Morris Sutton was using a 20-pound sledge to break a riser from a casting. He made a swinging blow, when the handle flew out of his hand and the sledge struck a man on the back of his head, fracturing his skull. After this it struck another man in the forehead, splitting his head open, and then it flew through a window and struck a third man on the shoulder, breaking his collar bone.

For some years past Chas. Churchill & Co., of London, have maintained in Manchester a machine shop which has been devoted particularly to the making of special tools to be used on automatic and other screw machines sold by them. The increase of business has caused these shops to be outgrown and the firm has therefore recently purchased new quarters much larger and better than the older ones into which they are now moving. It is intended to have the new shop especially well fitted up and to be in a sense a model machine shop, equipped of course almost, if not entirely, with American machine tools and doing work largely by American methods.

Personal.

Chas. P. Pollak has resigned his position as Eastern representative of Wickes Brothers, Saginaw, Mich., and will enter the employ of Fairbanks, Morse & Co., Chicago, Ill.

George H. E. Berthold has resigned his position with the Weston Electrical Instrument Company, of Waverly Park, Newark, N. J., and is now general foreman of the Battery Supplies Company, of Newark.

Ralph J. Venning, formerly advertising manager of the Cleveland Punch & Shear Works Company, has accepted the position of secretary of the Citizens Transit Company, of Cleveland, Ohio. This company has been formed to operate a line of electric passenger tonneau cars on the main streets and boulevards of Cleveland, using the Berg-Ledwinka type of motors and the Edison storage battery. Charles Berg, who controls the patent rights on this equipment, is president and general manager of the new company.

Obituary.

David McDowell, of the machinery firm of McDowell, Stocker & Co., Chicago, died at Eureka Springs, Ark., July 27.

George H. Longbottom, formerly pro-

ident of the Rogers Locomotive Works, died at Paterson, N. J., July 8, forty-seven years old. Mr. Longbottom entered the employ of the Rogers works thirty years ago as a machinist. He was later given a position in the office and rose steadily until four years ago he was made president of the company, which position he retained until the independent existence of the works terminated.

In a previous issue we published an obituary notice of George Richmond, chief engineer of the De La Vergne Company, in which we stated that circumstances pointed to his having asphyxiated himself with gas while laboring under mental depression due to self-imposed overwork. It now seems at least doubtful if his death was really suicidal. The coroner declared his death was due to apoplexy.

Business Items.

The shops of the Diamond Machine Company, Providence, R. I., will be closed from August 20 to 29 for stocktaking and general repairing. The office will be open for the transaction of business as usual.

The Hartford Blower Company, 140 Suffield street, Hartford, Conn., is rushed with orders and obliged to work overtime, and has greatly increased its plant and number of employees. Among the large orders received lately are three 160-inch fans and twenty-four heaters for the Eastern Tanners Glue Company, Gowanda, N. Y.; two large mechanical dust collecting systems for Wm. A. Rogers, Ltd., Niagara Falls, N. Y.; ten large heaters for the Hillman Tobacco Curer Company, Northampton, Mass., and a large mechanical dust collecting system for the Elm City Lumber Company, New Haven, Conn.

Manufacturers.

Mount Vernon, S. D., is opening bids for bonds for a small waterworks.

The Evansville (Ind.) Metal Bed Company is building a factory 360x100 feet.

The Bluff City Shoe Company, Hannibal, Mo., expects to build a new factory.

The paraffine plant of the Atlantic Refining Company, Philadelphia, has been burned.

A factory of the John C. Heughs Moulding Company, Rochester, N. Y., has been burned.

The Ideal Acetylene Gas Company will construct a manufacturing plant at Yankton, S. D.

The American Fruit Product Company, Rochester, N. Y., may build another large plant.

G. Moal, of Sibley, Ill., is promoting a concern to manufacture seeders at Davenport, Iowa.

The Eastman (Ga.) Cotton Mill Company proposes to install 3,000 spindles and 200 looms.

A plant of the Williamson Veneer Company, at Highlandtown, Baltimore, Md., has been burned.

The Oregon and Washington Lumber Company, Portland, Ore., will build a large new sawmill.

The Nebraska Moline Plow Company, Omaha, Neb., has contracted for an addition 66x66 feet, six stories.

The L. Felber Company, Baltimore, Md., will establish a plant for manufacturing yarns, hosiery and notions.

A factory of the Union Interior Finish Company, sashes, doors, etc., Chicago, has been badly damaged by fire.

Paint, coach and wood machinery shops of the Gulf, Colorado & Santa Fe Railway, at Cleburne, Tex., have been burned.

D. & H. Scoville, of Higganum, Conn., manufacturers of planters' hoes, have awarded the contract for an additional factory.

It is reported from Boston, Mass., that the Mystic Wharf elevator of the Boston & Maine Railroad Company has been burned.

The Hagerstown (Md.) Lounge Company is about starting to build a three-story building, 163x45 feet for factory purposes.

An electric power and lighting plant will be built at the Peabody (Mass.) works of the A. C. Lawrence Leather Company, Boston.

Fire originating in the ice plant of the Smyrna (Del.) Transportation & Manufacturing Company has caused considerable damage.

The Hendrick Manufacturing Company, perforated metals, Carbondale, Pa., contemplates enlarging its facilities either there or elsewhere.

The New Orleans (La.) Railways Company will make extensive improvements in its power system, and also improvements at the gas works.

A contract has been given for the construction of an addition, 60x180 feet, to the Niagara Falls (N. Y.) plant of the Ramapo Iron Works.

A digester building addition will be made to the plant at Winslow, Me., of the Hollingsworth & Whitney Company, paper, etc., Boston, Mass.

The Beaumont (Tex.) Water Supply Company is making preparations for the construction of a new water system. Colonel I. D. Polk is president.

The Mitchell-Vance Company, gas fixtures, etc., New York city, proposes to build a six-story factory, 50x91.4 feet irregular, at 503 West Twenty-fourth street.

The Little River Manufacturing Company, of Seymour, Conn., maker of novelties such as nail clippers, has increased its capitalization from $10,000 to $20,000.

J. H. Whistler, Benton Ridge, O., and Willis Reece are contemplating going into the graphophone business. A factory will be erected, and the machinery put in place soon.

The Progressive League, of Shreveport, La., is trying to raise $60,000 upon a proposition by Northern manufacturers for the establishment of a cotton mill of 10,000 spindles.

A big factory in Brooklyn, N. Y., of the Vehicle Equipment Company, which is engaged in the automobile industry, has been practically destroyed or badly damaged by fire.

Enrique Guerra, of Allende, State of Coahuila, Mex., has obtained a concession for an electric-light plant in that town which he will proceed to construct, using water power.

Merritt & Co., Philadelphia, manufacturers of architectural iron work, fireproofing, metal sanitary lockers, etc., have bought a valuable factory property, with power plant, in Camden, N. J.

Judge Frank S. Rawley, of Terre Haute, Ind., has filed papers of incorporation for the People's Brewing Company, of Terre Haute, which proposes to build a brewery. Capital stock, $200,000.

The commissfoner of the Industrial League, Memphis, Tenn., has received a proposition from a Northern piano manufacturing concern relative to moving to that place and building a large plant.

The Dover Yarn Mills, of Charlotte, N. C., have secured an amendment of charter to permit increasing capital from $90,000 to $180,000. It is understood that the money will be spent in improvements.

The Langley Manufacturing Company, West Point, Ga., has changed its name to Lang Manufacturing Company. An option has been secured on a building, which may probably be known as Lang Mill No. 2.

A large plant for the Reliable (not "Reliance") Gas Machine & Manufacturing Company, Davenport, Ia., is being built at Bettendorf, a suburb or part of that place. Herman Wernentin, Jr., is secretary and treasurer.

Russell Gardner, president of the Banner Buggy Company, of St. Louis, Mo., has decided to locate a wheel factory at Paducah, Ky., at the cost of about $100,000. The site has been selected. The plant will work about 150 men.

The Webster City, Ia., council has appointed a committee consisting of J. D. Riste, F. E. Willson and William Monroe, with power to act to erect and construct a gas plant. A franchise has also been asked for by M. E. Springer.

Jas. F. Burnam, of Madison, Ala.; C. C. Green and Milton Lanier, a Huntsville attorney, have formed a company for the manufacture of the Wear-Proof Pneumatic Tire Protector. The factory will be located in Huntsville.

The Davis Hosiery Mill Company has applied for a charter at Chattanooga, Tenn. G. H. Miller, a merchant of that place, is president; W. B. Davis, treasurer and manager. The plant is expected to be in operation by November 1.

John A. Roebling's Sons Company is said to have purchased a tract of 200 acres or more near Florence, N. J., for the erection of a big plant to be operated in connection with the one in Trenton. The report, however, is unverified.

It is stated in Denver, Colo., that D. Moore, of Roanoke, Va., has called at the headquarters of the Colorado Promotion and Publicity Committee to obtain information concerning Colorado cities tentative to the establishment of a large washing machine factory.

The J. F. Eesley Milling Company, Plainwell, Mich., will install an electric power plant. It proposes placing two wheels that will generate enough electricity to furnish between 300 and 400 horse-power. An engine and boilers will be added if need be.

The Galena (Ill.) Axle Grease Company has increased its capital stock to manufacture automatic weighing and can-filling machinery invented by the company's superintendent. Machinery and tools have been installed in a part of the company's plant for the purpose.

The Chattanooga (Tenn.) Plow Company is erecting a power plant and grinding department, and compressed air and electrical devices will be installed for painting plows and driving machinery. These improvements will involve an expenditure of about $50,000.

It is stated at Chattanooga, Tenn., that the Soil Pipe Works is preparing to build an addition to its plant at Vulcan street and the Nashville, Chattanooga & St. Louis Railway in South Chattanooga. The concern manufactures gray-iron soil pipe and plumbers' gray-iron goods.

It is stated at Youngstown, Ohio, that Frank L. Cleveland, who has resigned from the management of the East Youngstown Land & Improvement Company, will go to Cuba as general manager of a company organized to run a cotton compress and gin at the beginning and a little later to put in a cottonseed oil plant at Bahia Honda, Cuba. Mr. Cleveland is expected to spend the month of July purchasing machinery.

The Parkhurst Manufacturing Company, of Indianapolis, Ind., which has just incorporated with a capital stock of $50,000, will erect a new factory. The concern, which was formerly known as Parkhurst Brothers & Co., will enlarge its capacity and the number of its employees. The company manufactures machinery, castings, etc.

The Heffernan Engine Works, Seattle, Wash., are to have new plant which, it is said, exclusive of the land will represent an investment of $250,000. The best machinery will be installed and the work of building steamships will be facilitated by a big traveling crane that will carry materials from the shops to the drydock.

The Georgia Fertilizer Company has applied for a charter at Columbus, the incorporators being O. C. Bullock and John T. Fletcher, of Columbus, and J. W. Howard and J. H. Carpenter, of Maury county, Tenn. The authorized capital stock will be $200,000. The company proposes to erect a fertilizer factory just east of Columbus.

Arrangements have been made for the location at Leeds, Sioux City, Ia., of a company to manufacture the Skidmore wagon scale. The capital has been placed to the amount of $100,000 by Dakota and Nebraska capitalists. Parties interested are E. Sinclair, of Mitchell, S. D.; P. Champlin, of Vermillion, S. D., and George Skidmore and his son, of Homer, Neb.

The Cherokee Development & Manufacturing Company has perfected plans to build a large water power plant at Cherokee Bluff, on the Tallapoosa river and supply electric power to the city of Birmingham, Ala., 85 miles away. It is proposed to develop 25,000 horse-power to augment 100,000 horse-power now in use there. Henry C. Jones, of Montgomery, is engineer for the company.

The industries of Victoria, B. C., are receiving an important addition by the establishment of the works of the British Columbia Foundry & Engineering Works, Ltd., at Esquimault. The erection of the principal buildings is about completed and the installation of the plant has commenced. The company's capitalization is $100,000. The works are to be run by electricity.

The Reed Manufacturing Company, of Springfield, Ohio, has been incorporated with a capital of $50,000, the principal incorporators being George L. Reed and Frank C. Reed. For some time they have been engaged in the manufacture of looms for making carpets, rugs and the like. The company will also manufacture the washing machine and the incubator formerly manufactured by Reed Brothers. Plans for a factory building are said to be under way, but nothing definite along this line has yet been announced.

The Waterloo (Ia.) Automatic Stone Machine Company, is being organized with $100,000 capital stock by Thomas Cascaden, Jr., J. R. Vaughan, Wm. Vaughan, C. B. Hubbard and others, to make machines invented by Wm. Raab, of 205 Utica street, Waterloo. There is a hand and an automatic compressed air machine; also a hydraulic attachment. The company expects at first to install equipment for their manufacture in the Cascaden factory on Commercial street, and next spring erect a new factory.

The capital stock of the Standard Roller Bearing Company, Philadelphia, Pa., has been increased from one million to two million dollars. There will be immediately erected a 250-foot addition to the machine shop and factory, as well as an office building, two stories. This addition will be devoted exclusively to the manufacture of roller bearings, etc., while an addition 50x125 feet, three stories, will be made to the ball plant and be in full operation within sixty days. $250,000 will be expended in the construction of the above buildings and in equipping them with machinery. Contracts for the buildings and some of the machinery have already been given, and it is expected that all of the building operations will have been finished by the first of October. Two years ago the company purchased in Philadelphia about three acres of ground on the main line of the Pennsylvania Railroad. It has erected a machine shop, with power house, forging and hardening departments in separate buildings; also brass and iron foundries. At the present time it does not purchase anything in the open market except the raw iron and copper, etc., for its foundries and steel from which to make bearings, manufacturing all other devices itself. The business continues to grow so rapidly that it has become necessary to build the extensions above noted. For about one year past the plant has been running with two gangs, twenty-four hours per day, and for the past six months the ball plant has also been running day and night.

New Catalogs.

Challenge Machine Company, Inc., Philadelphia, Pa. 1904 mailing catalog of emery grinders. Illustrated. 3½x6, pp. 34, paper.

Canadian General Electric Company, Toronto, Ont. Bulletin No. 831, "Meridian Lamps." Illustrated. 10½x8, pp. 12, paper.

American Luxfer Prism Company, New York. The Luxfer system for daylight illumination of buildings. Applications illustrated. 4½x9½, pp. 20, paper.

Schellenbach & Radcliffe, Cincinnati, Ohio. Catalog and price list of universal adjustable reamers and tools made by this company. Illustrated. 3¾x6, pp. 12, paper.

"A Short Story of William Symington" is the latest addition to the series of brief biographies of famous engineers published by Wyman & Gordon, makers of drop forgings, Worcester, Mass.

The Goldschmidt Thermit Company, Wall Street Exchange Building, New York. Illustrated folder, giving in condensed form information regarding the composition and uses of aluminothermics.

Manhattan Electrical Supply Company, New York. General catalog and price list of electric light, telephone, household, telegraph and railway, and all kinds of electrical supplies. Illustrated. 6x8¾, pp. 640, paper.

Standard Brazing Company, Boston, Mass. Catalog descriptive of the "Tichon" process for brazing cast iron, with illustrations from photographs showing results attained on difficult brazing jobs. 6x9¼, pp. 12, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Estimates furnished on pattern work. Globe Pattern Works, Kalamazoo, Mich.

Will buy or pay royalty for good patented machine or tool. Box 282, Amer. Mach.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N.J.

Working drawings, tracings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Second-hand vertical boring mill, 60 or 72 in.; must be in good condition. Ft. Scott Mfg. Co., Ft. Scott, Kan.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

A director of methods for increasing machine shop output solicits engagements; vast experience; excellent record. Box 104, A. M.

Addressing machines without type; high speed; run by motor or foot power; write for the picture book. B. F. Joline & Co., 123 Liberty st., New York.

Wanted—To build, by day labor or contract, medium weight or heavy machines or parts for machines; ideas developed and machines built; our plant is new and up to date; 36 years' experience. Address M., care American Machinist.

For Sale.

Working drawings for up-to-date gas engines from 2 H.P. to 300 H.P.; special for electric light; also air-cooled automobile engines. Address Box 114, Amer. Machinist.

For Sale—Two 50 H.P. General Electric standard type "L," three-phase, 220 volt, 24-cycle, alternating current motors; 800 R. P. M.; used only few weeks; absolutely good as new. Box 127, American Machinist.

For Sale—An old-established pattern shop; excellent reputation; centrally located in New York city; equipped with up-to-date woodworking machinery; splendid opportunity for energetic party; selling because another line requires more attention. Address "Patterns," care American Machinist.

For Sale—An interest in or control of a patented pneumatic drill, costing less to construct, more durable, having fewer wearing parts and occupying less space than other similar machines; drills a hole 2½ in. from edge of machine. Address John D. Cloud, 2808 Harold st., Philadelphia, Pa.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Traveler—Special machinery and machine tools—desires position in United States or for Canada. Good connections. Address Drawer U, Sarnia, Ontario, Canada.

CONNECTICUT.

Wanted—Position as foreman patternmaker (wood); willing to work at the bench. "Patternmaker," care American Machinist.

Mechanical draftsman or assistant superintendent, 26, being a technical graduate with four years' practical experience; best references. Box 113, American Machinist.

Wanted, position as superintendent or general foreman by a thorough, practical mechanic with 12 years' experience; age 39; member of A. S. M. E. Box 116, Am. Mach.

MASSACHUSETTS.

Expert practical mechanic, American, age 36; last six years general foreman and superintendent; executive and inventive abilities; fine draftsman; references; East preferred. Box 115, American Machinist.

MICHIGAN.

Experienced foreman patternmaker, now employed, desires to change. Box 122, A. M.

NEW YORK.

Draftsman, designer, with shop experience, seeks position. Box 108, Amer. Machinist.

Mechanical draftsman, familiar with shop work, desires position. Box 120, Am. Mach.

Mechanical draftsman; 8 years' experience; rapid detailer. Box 121, Amer. Machinist.

First-class mechanical draftsman wants to change position. Box 128, Amer. Machinist.

Machine shop foreman wants position; refers to Cameron Steam Pump Works, East 23rd st., New York. Address Box 124, A. M.

Situation wanted as foreman or erecting engineer; experienced in high-speed engines, gas and automobile engines. Address S., care American Machinist.

Expert systematizer, young man, 10 years' experience in business, shop and cost sys-

tems, reliable manager, desires new position. Address Box 126, AMERICAN MACHINIST.

Wanted—Position toolroom or machine shop foreman; practical; good designer; 10 years as foreman and superintendent; technical education. Address Box 119, AM. M.

Position as superintendent or works manager; good executive; first-class mechanic and successfully filling former position with leading concern. Box 117, AMER. MACHINIST.

Expert mechanic, progressive, 20 years' experience in duplicate and general machinery, first-class reference as general foreman, desires responsible position. Box 118, AM. M.

OHIO.

A successful man of extensive practical experience in manufacturing is prepared to accept the management of a large or medium factory, consisting of foundry, machine shop, boiler, blacksmith or wood-working departments, with a percentage of the profits as remuneration; an excellent opportunity for parties in possession of plants from which they are not receiving satisfactory returns, through lack of modern methods or fear of labor troubles. Address Box 106, AM. M.

PENNSYLVANIA.

Automatic screw machine hand desires position. Address Box 125, AMER. MACHINIST.

VIRGINIA.

Progressive mechanical superintendent, familiar with manufacturing and jobbing machine work, would like to correspond with parties in need of a reliable man; will be open for change August 15; Southern States preferred. Box 123, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—First-class operator for Jones & Lamson lathe. Apply Ross Rifle Co., Quebec, Canada.

Wanted—A competent foreman to take charge of the erection and installation of interlocking plants; give experience and reference. Box 88, AMERICAN MACHINIST.

FLORIDA.

Wanted—A thorough job shop machinist; one competent to act as foreman when necessary. Address Florida Machine Works, Jacksonville, Fla.

ILLINOIS.

Draftsman—Mechanical; experienced designer of power punches, shears, bending rolls, etc.; must be A1. S 6529, AM. MACH.

MICHIGAN.

A good wood pattern maker; steady work. Globe Pattern Works, Kalamazoo, Mich.

NEW YORK.

A superintendent and chief draftsman wanted for old-established, highly successful manufacturing company; investment required, but thoroughly protected; attractive salaries to right men. Box 129, AM. MACH.

OHIO.

Wanted—Draftsman, technical graduate, experienced in making tool design and in up-to-date drawing room and shop practice; good position; references required. Box 9, AMER. MACHINIST.

PENNSYLVANIA.

Toolmaker on gasoline engines and carburetors wanted. State experience and wages. Bradford Motor Works, Bradford, Pa.

Chief draftsman on rolling mill and machine tool work. Applicants must state experience, references, and salary expected. Address "Geering," care AMER. MACHINIST.

The Monotype Company maintains a school to train young men to meet the constantly increasing demand for operators of its type casting and composing machine. These operators have done so well that it receives more applications for places than can be filled. In making selections these qualifications carry most weight: common sense, type foundry experience, printing office experience, automatic machinery experience. Full particulars will be furnished to inquirers who furnish the same information about themselves. The Lanston Monotype Machine Co., 1231 Callowhill st., Philadelphia, Pa.

WEST OF MISSISSIPPI.

Three first-class machinists; general hands; one must thoroughly understand operation of roll grinding and corrugating machines; steady work; "open shop." Address Box 488, AMERICAN MACHINIST.

WISCONSIN.

Machine foreman wanted; none but first class need apply; work heavy and light; good salary to right man. Address "High Speed," care AMERICAN MACHINIST.

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Jacobs Mfg. Co	82
Jacobson Mach. Mfg. Co	70
Jantz & Leist Electric Co	86
Jeffrey Mfg. Co., The	100
Jenkins Brothers	79
Johnson Machine Co., Carlyle.	81
Jones & Lamson Machine Co.	12 and 18
Kent & Co., Edwin R	94
Keuffel & Esser Co	87
Keystone Electric Co	87
Landis Tool Co	57
Lane Mfg. Co	98
Lapointe Machine Tool Co	78
Le Blond Machine Tool Co., R. K	4th Cover
Le Count, Wm. G	82
Link-Belt Engineering Co	88
Lodge & Shipley Mch. Tool Co.	4
Long & Allstatter Co., The	71
Lunkenheimer Co., The	79
McCabe, J. J	87 and 100
McCrosky Mfg. Co., F. B	92
McGeorge & Sons	94
Maris Bros	98
Marshall & Huschart Mch. Co.	101
Meisel Press & Mfg. Co.	72 and 94
Merrell Mfg. Co	83
Merritt & Co	99
Mich. College of Mines	92
Mietz, A	70
Miner & Peck Mfg. Co	90
Modern Tool Co	77
Morse Chain Co	76
Morse Twist Drill & Mach. Co.	17
Mueller Mach. Tool Co	77
National-Acme Mfg. Co	102
New Britain Machine Co	71
New Era Gas Engine Co	70
New Haven Mfg. Co	71
New Process Raw Hide Co	72
Newton Mach. Tool Wks., Inc.	11
Ney, R. W	94
Nicholson & Co., W. H	63
Nicholson File Co	17
Niles-Bement-Pond Co	100, 103, 104, 105 and 106
Nolte Brass Co	69
Northampton Emery Wheel Co	73
Northern Electrical Mfg. Co.	85
Northern Engineering Works.	98
Norton, A. O	83
Norton Emery Wheel Co	89
Norton Grinding Co	75
Nuttall Co., R. D	72
O. K. Tool Holder Co	86
Olds Gasoline Engine Works.	69
Oliver Machinery Co	88
Parker Co., Chas	73
Patterson, Gottfried & Hunter, Ltd	66
Pawling & Harnischfeger	98
Paxson Co., J. W	70
Penn Pattern & Model Works.	71
Perkins Machine Co	91
Philadelphia Bourse	69
Philadelphia Gear Works	72
Phosphor Bronze Smelting Co.	76
Pittsburg Blue Print Co	87
Pond Mach. & Foundry Co., L. W	83
Poole Co., J. Morton	99
Potter & Johnston Mach. Co.	63
Power & Speed Controller Co.	75
Pratt Chuck Co	82
Pratt & Whitney Co	2 and 3
Prentiss Tool & Supply Co	100
Prentiss Vise Co	73

Some Things Seen at the Fellows Gear Shaper Shop.

EDITORIAL CORRESPONDENCE.

A SPECIAL CUTTER GRINDER.

The Fellows Gear Shaper Company, of Springfield, Vt., finishes both sides of its gear cutters, after hardening, on an automatic grinder which has an oscillating head for moving the work to and fro past the wheel, and a ratchet and pawl driven cam-shaft for feeding the wheel to the cut at the commencement of each stroke. This machine is illustrated in Figs. 1 and 2, the latter giving four views and bringing out distinctly every feature of importance.

The work spindle, as will be discovered by examining the drawing, is mounted in a head which is provided with a graduated, swiveling base, to allow the spindle to be swung round to the desired angle when the concave upper face of the cutter is to be grooved. The oscillating member *A* supporting the swiveling head is secured to a rock shaft at the front of the bed and actuated by the rocker arm at the right-hand end of the shaft, the arm itself being swung up and down by connecting rod and crank disk, gear driven from the belt pulley at the rear. The length of the rocker arm connection may be changed by means of the knurled nut; and as the crank pin is adjustable across the face of the disk, the swing of the work spindle is easily varied to accommodate different diameters of cutters.

The wheel spindle is mounted in a head *B* which is hung upon a shaft journaled at right angles to the rock shaft for the cutter head; and a weight suspended from the rear of the wheel spindle bracket keeps a roller carried by that member in contact with a feed cam at *C*. The shaft for the latter is rotated, as indicated, through the medium of worm and worm-wheel. To bring the wheel quickly to the cut, the hand-wheel at the front of the worm-shaft is made use of. Once set, the worm gear and cam are rotated slowly and intermittently by ratchet and pawl *D*. The mechanism actuating the pawl requires no explanation further than the statement that the pin lifting lever *E* is so located in the rear of the disk, relatively to the crank pin, that the pawl is moved forward and the wheel fed at the moment its face is cleared by the work.

In the layout of the cam to larger scale, it will be seen that the feeding portion occupies nearly 180 degrees of arc; then follows a dwell of about 45 degrees, during which the work passes back and forth across the wheel and is finished without further application of the feed movement. The outline of the cam then permits the wheel head to be swung quickly by the weight, and to be brought forward again rapidly after the cutter has been removed and another slipped into position for grinding. The method of holding the cutter while either face is being ground is brought out plainly in the longitudinal section through the work spindle; and the arrangement for adjusting the cam roll to compensate for the wear of the emery wheel is also clearly indicated. Emery and steel dust are taken care of by an exhaust fan under the floor.

A CURIOUS PIECE OF GRINDING.

While writing of cutter grinding, I am going to mention a little job in this line which was shown me at the time I was watching the above grinder in operation, and which, though unintentionally performed, is none the less interesting on that account. As all know, the Fellows cutter, after it is roughed out and hardened, is secured to a rolling spindle in a generating machine, where the sides of the teeth are ground to correct contour by being rolled past the side of a wheel corresponding to a rack tooth. In order to grind to the bottom of the tooth, it is necessary that the wheel be very thin at the periphery. However, as indicated by the grinding performance revealed in Fig. 3, this thin wheel, which is of special abrasive and bonding material, is anything but a weak affair.

The cutter shown is, I believe, 16 diametral pitch. While its teeth were being roughed out it apparently slipped on the arbor, and when it was placed in the generating machine to have its teeth ground, a surprising amount of work was gradually thrown upon the wheel. The latter stood up to the work nevertheless, and the cut got heavier and heavier until finally a tooth was split right in the center at each rolling movement of the cutter spindle.

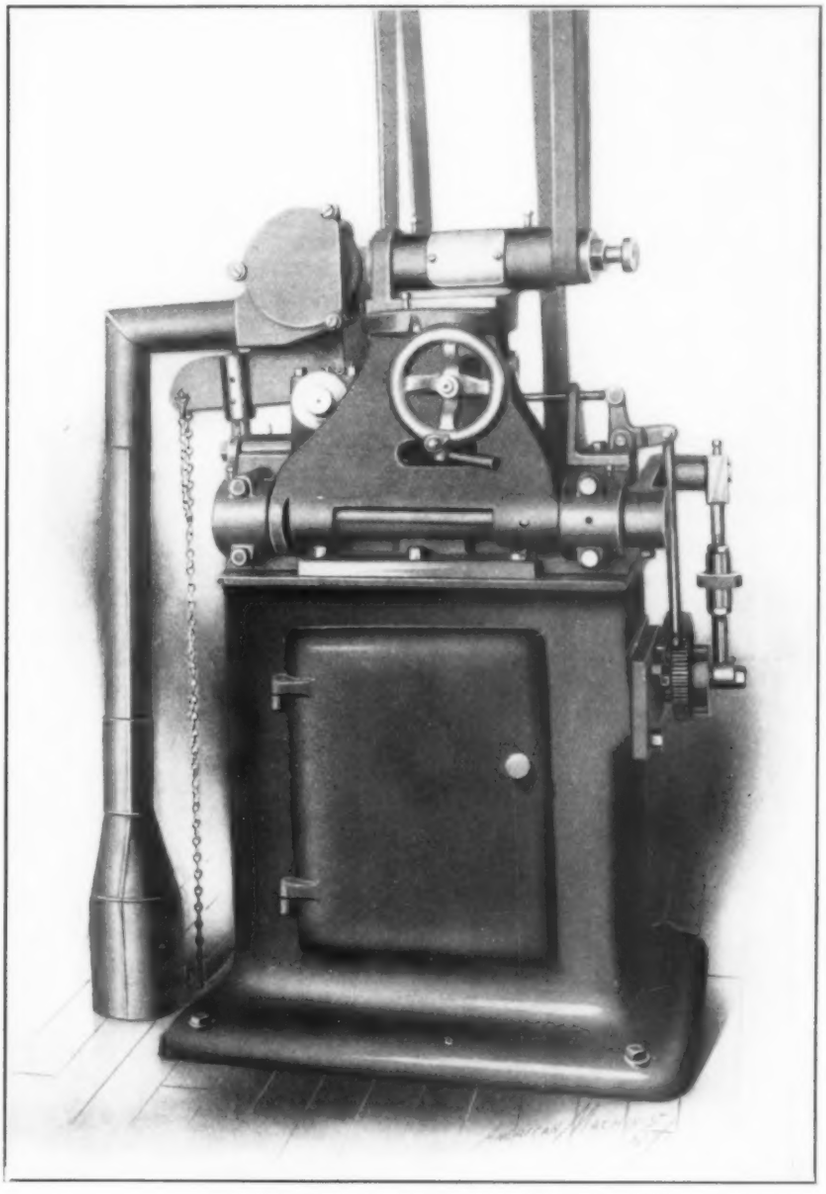


FIG. 1. SPECIAL CUTTER GRINDER.

GEAR SHAPING WITH CUTTERS OF HIGH-SPEED STEEL.

At the Gear Shaper shop—as in most other tool-building establishments—considerable attention is being paid nowadays to

the high-speed steel question; and some interesting results are being obtained with gear cutters made from some of these steels. One lot of malleable iron gears I saw handled in the 36-inch shaper were machined with a high-speed cutter having a cutting speed of 63 feet per minute, the ram making 94 strokes per minute. The gears were 18 inches pitch diameter and 8 diametral pitch, and had therefore 144 teeth; the width of face was 2 inches, and two gears were cut at once. Two cuts were taken around the gears and the time required for each cut was 19½ minutes. In other words, the time required in shaping one gear complete was but 19½ minutes—plus about one minute for the depthing feed. The total length of the 144 teeth being 576 inches, the tooth length gone over per minute each cut equals 29 inches, the length of tooth finished per minute by the two cuts being 14½ inches. The average feed per cutting stroke, figuring along the pitch circle, is .0305 inch; the feed along the finished surface of the tooth—following the involute curves—is .043 inch per stroke of cutter. At the time I watched the cutter in operation, it had already machined forty-five of these gears, yet apparently was just getting ready for business, it showing upon close examination no signs of dullness whatever. A stream of soda water was kept on the work and the teeth were given an excellent finish.

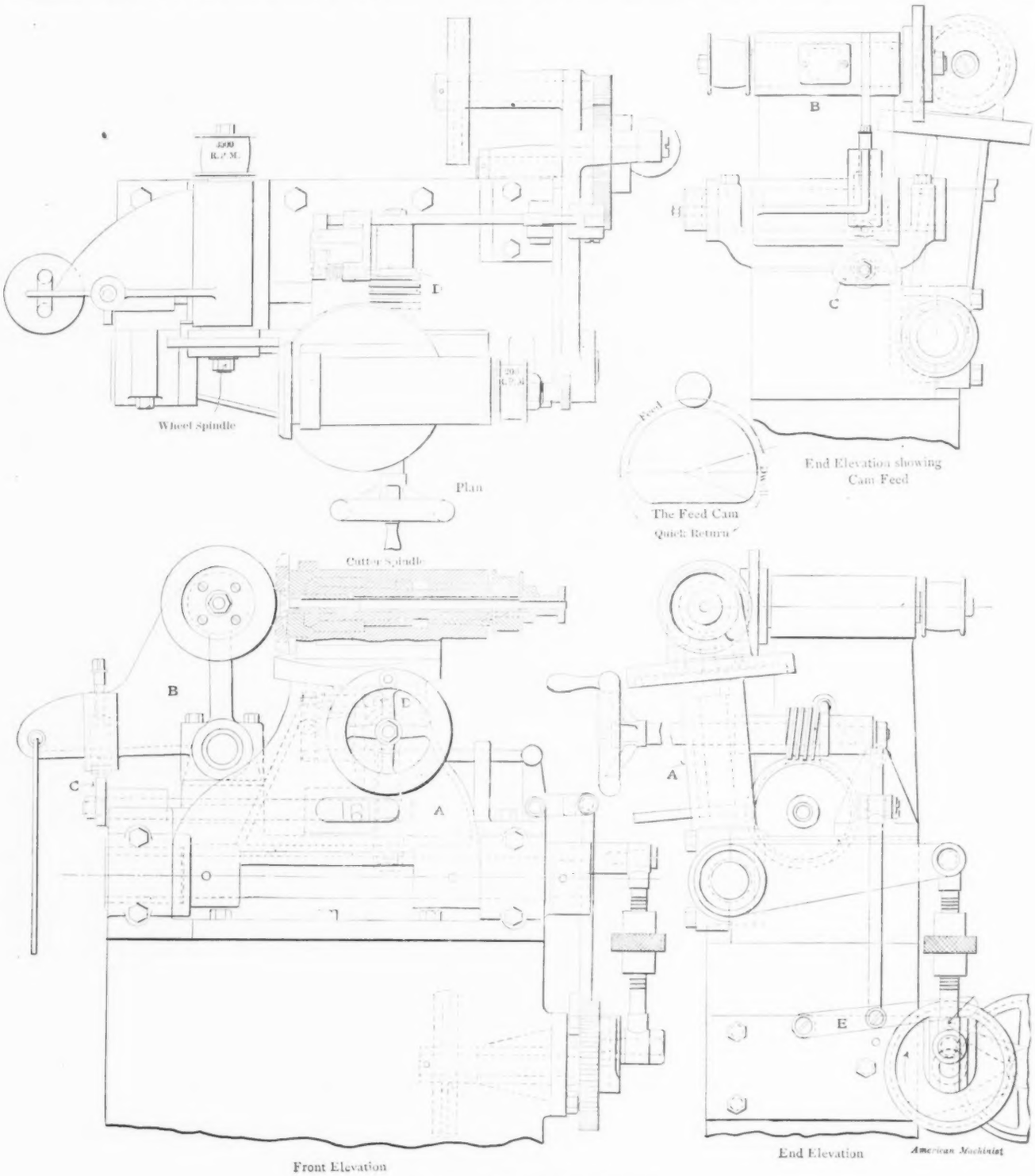


FIG. 2. CUTTER GRINDER CONSTRUCTION.

Particulars of another job of gear cutting with a high-speed cutter are given on

the data card shown in Fig. 4. As will be observed, this gear, of gray iron, was 4 diametral pitch and had 96 teeth, the length of face being 3 7-16 inches. Two cuts were taken around the blank and the work was completed in 70 minutes. Running out these figures on the slide rule gives a total length of 330 inches of tooth finished in the two cuts in 70 minutes, or about 4.7 inches of finished tooth per minute.

The data card is reproduced about three-quarter size, its actual dimensions being

FIG. 3. A CURIOUS JOB OF GRINDING.

4x6 inches. One of these cards is filled out for every new piece of work going through the gear shaper and is then filed for future reference. F. A. S.

The Special Apprentice.

The following is from a paper by R. D. Smith presented at the recent convention of the Railway Master Mechanics' Association:

The special apprentice system is, at best, a poor one. The technical graduate is put in the shop and is given the best of opportunities to learn. He is given a great deal more attention than the ordinary apprentice. He is favored, and what is worse he expects it. On this account in a great many cases we turn out men who would have been a great deal better off if they had been given to understand that their advancement depended entirely on their own exertions. We favor them and turn out a hothouse plant which, when finally transplanted, cannot stand the cold blast of competition. At the same time that the special apprentice is being favored, the general effect on the shop is not good. When the other men in the shop see the technical graduate rushed ahead they are not liable to be nearly so energetic as when they see that all men are being treated alike. The more you take away from a man his prospect for promotion, the less valuable he becomes. If every man in the service feels that his chance for promotion is as good as that of anyone else, you will have an organization which will do business and be free from discord.

Electricity and Steam on the Railroad.*

The past year has brought remarkable progress in machinery, tools, and shop equipment. This has found its greatest development in commercial establishments, but we have been busy in applying the improved practises in our locomotive and car shops. We are, however, only beginning to develop in this direction, and there is much to be gained by applying methods for increasing production and improving shop methods.

Much is being said and written concerning the conflict between electricity and steam. Electricity is said to be about to drive steam out of the field. I see no conflict whatever. I recognize that electricity can do certain things better than steam, and that it will gradually extend its field to meet new requirements which steam cannot reach. There is no occasion, however, for any anxiety or any fear of conflict, but rather we should receive it with open arms. In shop practise it has worked wonders and bids fair to revolutionize some of our present methods and equipment. The days of long line shafting, isolated steam engines and boiler plants are fast disappearing, and their places are being taken by central power plants, central electrical plant and systems of power distribution. This has brought out power cranes within reach of all departments, serving as an ally to the labor-saving

LOT NO. _____ GEAR CUTTING DATA. DATE _____

FOR _____

INTERNAL X EXTERNAL _____ SPROCKET _____

MATERIAL	C.I.	REMARKS
NUMBER OF TEETH	96	
LENGTH OF FACE	3 7/16	H.S. Cutter.
PITCH	4	
NO. OF CUTS	2	
NO. OF GEARS AT TIME	1	
SPEED OF MACHINE	96 str.	
FEED GEARS	Special	
CUTTING TIME	70 min.	

FIG. 4. GEAR CUTTING DATA CARD.

methods by the use of compressed air, and opening up an entire new field in machine tools. Machine-tool builders are trying to meet the advanced methods of designing and bringing their products up to sufficient capacity of the variable speed motors. These tools in combination with high-speed steel are rapidly changing shop conditions and practises. Years will pass, however, before the steam locomotive will give place to electricity, but that it may do so in the future is not beyond the range of possibility, as indicated by the rapid advance which has been made in New York city and other places. The extension of its use will be gradual, and many new problems will appear in connection with electricity, and they are being slowly worked out. They can best be met by men of experience. It behooves us, therefore, to look out that the development does not pass into other hands, or someone some day may write of the "passing of the master mechanic."

I wish to impress upon the younger men who are before me to-day these opportunities which they must not lose. The members of this association must look deeply into electricity as we now have it, for there is surely more to come in the future. The development in electricity is not like that of the locomotive, an evolution, but the rapid development constitutes rather a revolution which finds the average mechanic of to-day totally unprepared to meet it. The demands of the future will require a knowledge other than that possessed by the locomotive and car builder of to-day; it will require a combination man, not only capable of meeting the demands upon him for construction and maintenance of cars and locomotives, but a full knowledge of electricity as a motive power. I see no reason for fear of a conflict between electricity and steam, but rather an inducement for the mechanical man to familiarize himself with the principles of electricity as a motive power, and thereby to fit himself to become the combination man.

*From the address of W. H. Lewis, president of the Railway Master Mechanics' Association.

Australasian Hardware and Machinery publishes a contributed article from W. E. Downing, of John Alderdice & Co., in which he describes a system of catalog filing based upon the article published in the AMERICAN MACHINIST at page 786, Vol. 25, and which article described the system of catalog filing in use in this office. It is the experience of the firm named that this is the best system for their use they have been able to learn of.

The St. Louis Exposition—VIII.

EDITORIAL CORRESPONDENCE.

THE BALTIMORE & OHIO EXHIBIT OF OLD LOCOMOTIVES AND REPRODUCTIONS.

No description of this remarkable collection could be complete that did not include an account of the extended researches by Major J. G. Pangborn, of the Baltimore & Ohio Railroad, on which the collection is based.

Major Pangborn's interest in the history of the locomotive dates from the early eighties. At the New Orleans Exposition he had half-size reproductions of the "Tom Thumb" and the "Arabian" on exhibition. Shortly after this he came in contact with many old employees of the Baltimore & Ohio whose recollection of early events was still keen, and this so quickened his interest that he took measures to see that existing Baltimore & Ohio relics of this character should be preserved from the scrap heap. Later he obtained a substantial appropriation from the company for an exhibit at the Chicago Exposition of 1893, and with this appropriation constructed some of the reproductions which are here again on view. In preparing for that exhibit, he went to England and took with him the foreman who was to install it. In Europe he first looked up the existing old engines in the South Kensington Museum, and then went to Paris to consult a model-maker regarding the preparation of reproductions. Here he was so fortunate as to get a view of the Cugnot, which he found on storage and covered with the dust of many years. Meanwhile he put men at work hunting up additional facts in England, and in 1891 found and bought in Birmingham an extensive railroad library containing many old books, and among them a complete file of the first railroad journal in England, from its first issue and under several names, down to 1885. These journals supplied a mine of information, but going still further, he placed advertisements in many English papers, especially those of Manchester, for additional information. In this and other ways he found the descendants of the early pioneers, and thus succeeded in finding, preserved as family heirlooms, many old drawings and letters. These latter were quite as interesting as the former, being full of stories of the trials and difficulties of the experimenters, as well as of the unquenchable spirit of hope and faith.

In the attic of a building near Manchester, occupied on its ground floor only, he found a large collection of original drawings and papers by George Stephenson, many of them signed by him. This room had obviously been occupied by Stephenson as a consultation room, and perhaps also as a drafting room. Wherever possible, these old papers were bought and shipped to America. In such ways as this he obtained many original drawings by Trevithick and Hackworth. Similar advertisements were also inserted in Philadelphia, New England and New York papers, and descendants of American pioneers in locomotive construction were thus found, some of whom had in their possession original drawings of early locomotives.

Finally all of this information was turned over to Mr. Wright, formerly chief draftsman of the Baldwin Locomotive Works, by whom the working drawings for these reproductions were made. It should be understood that the reproductions are all working models in the sense that they may be turned over, and as a matter of fact all of them have been turned over, and many of them for hours at a time—the models being jacked up and then driven by a belted connection to

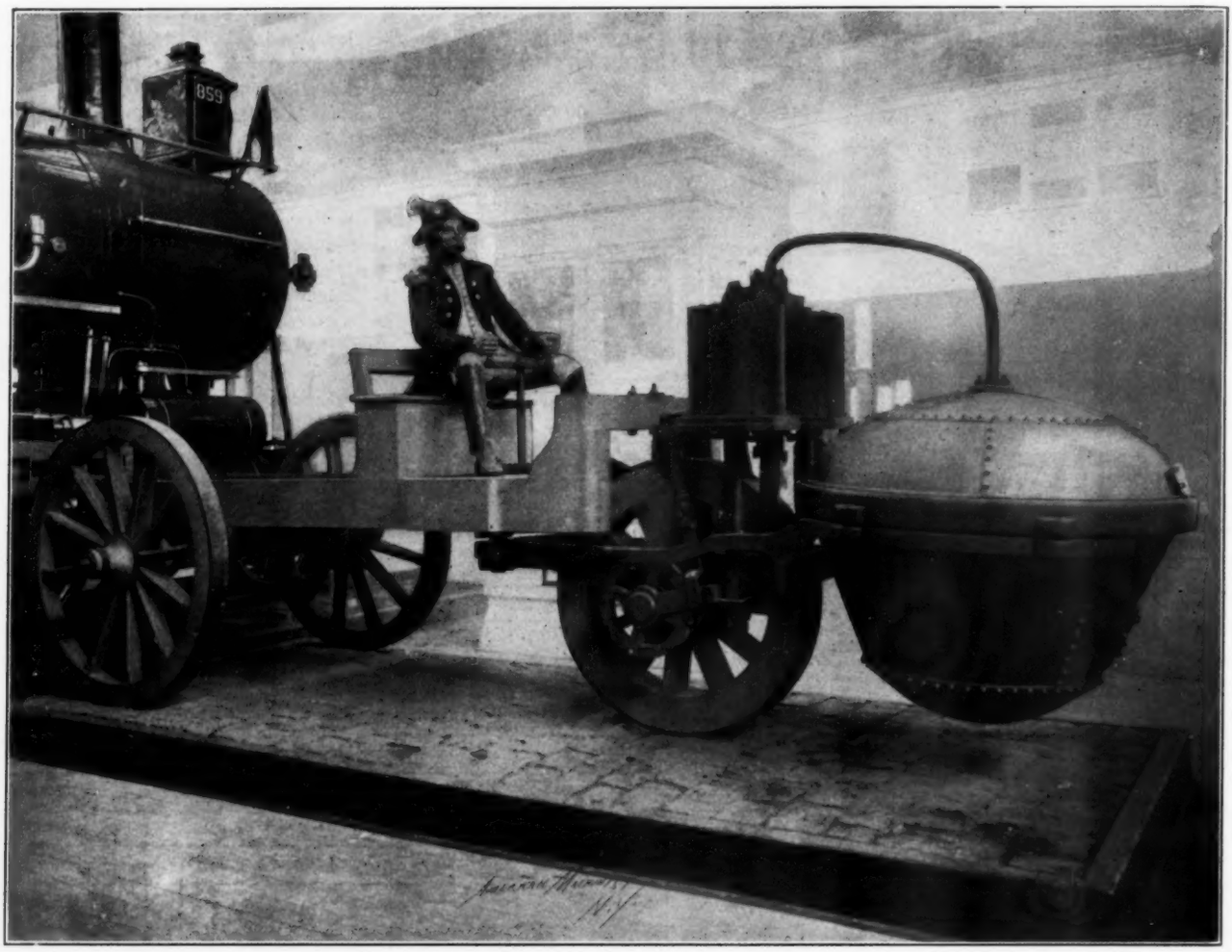


FIG. 1. THE CUGNOT—1769-71. THE FIRST STEAM-DRIVEN CARRIAGE.

the driving shaft. In the case of engines which still exist in Europe, working drawings were made from which the models have been constructed. There can thus be no doubt that these reproductions faithfully represent the originals of those engines whose disappearance we can now but vainly regret. A striking feature of the reproductions, as well as of the original engines, of which the collection contains many, is the fact that they are manned with life-size wax figures. As can be seen from the illustrations, these are strikingly realistic. They do not represent Eden Musee work, but were done by a Baltimore sculptor. Each one represents a study for its particular place, and if other observers do not find themselves starting towards some of them to ask questions of them, their experience will be less amusing than my own.

The most embarrassing feature in making the selections of the engines to be photographed has been to determine the ones to be left out. The illustrations will include about one-half of the collection. In making the selections the idea has been to select those which formed important links in the history of the locomotive with some that formed important starting points in a historical sense.

Omitting some models which represent ideas that were never executed and which

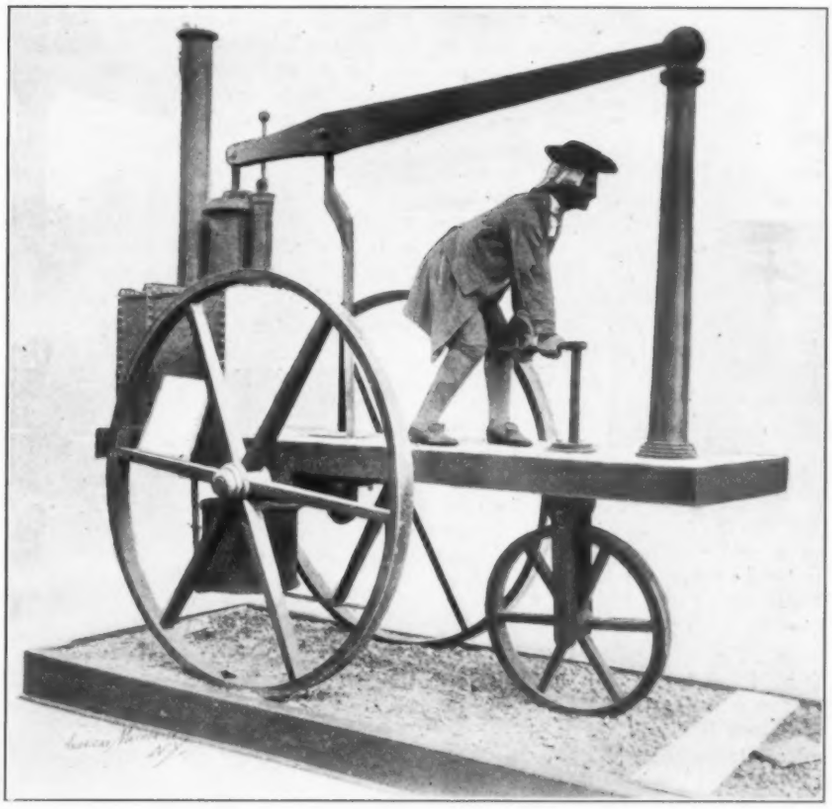


FIG. 2. THE MURDOCH—1784.

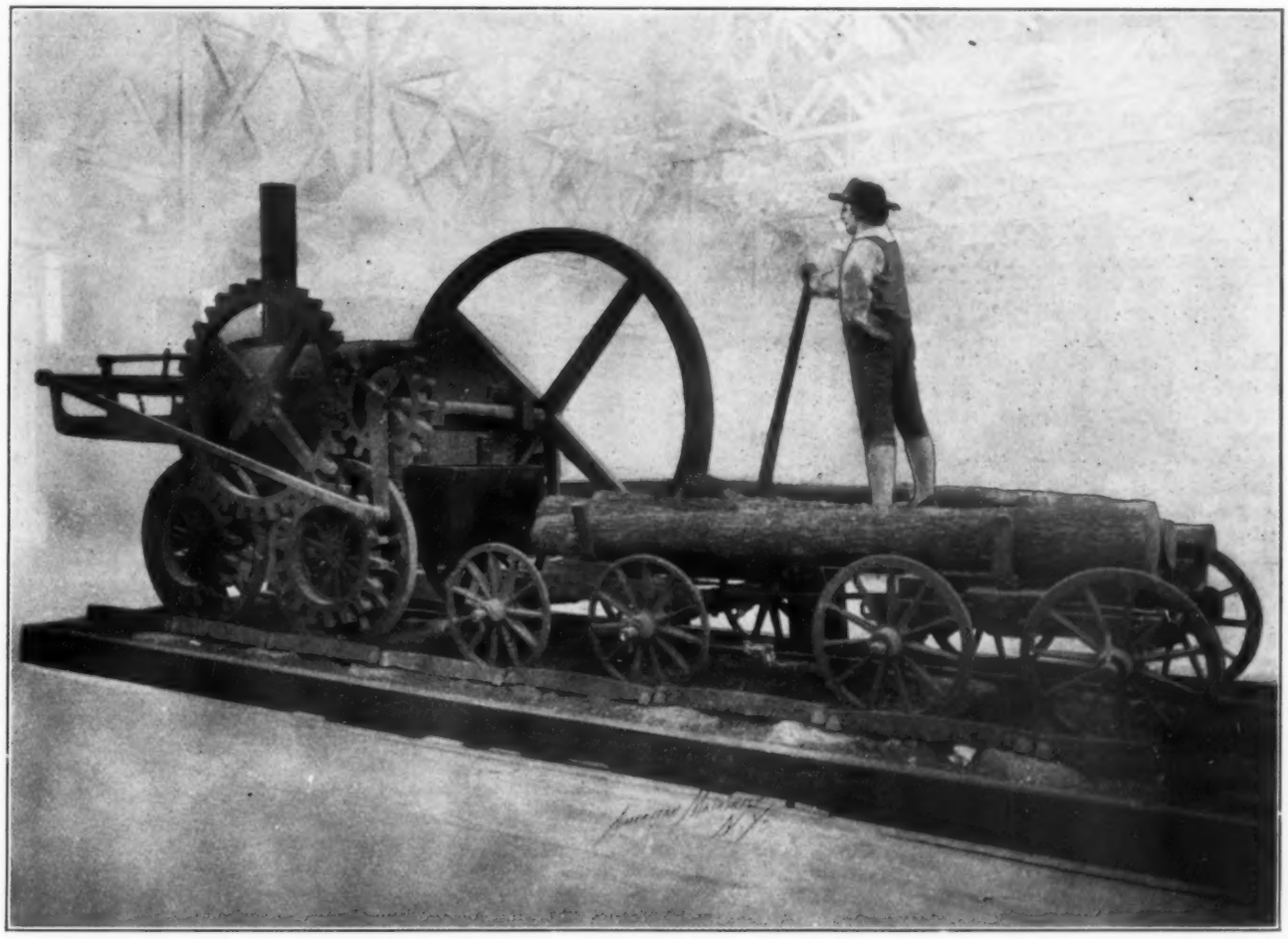


FIG. 3. THE TREVITHICK—1804. THE FIRST TO MOVE ON RAILS.

were thus dreams rather than inventions, Fig. 1 shows the Cugnot built by Nicholas J. Cugnot, a French officer of artillery, in 1769-1771. This machine was designed to take the place of horses in drawing artillery, and is the very first example of a steam-driven carriage to be constructed. The model which is here shown is an exact reproduction of the original machine which is now preserved in the Conservatoire des Arts et Métiers at Paris. This machine actually ran under steam—not very far nor very rapidly it is true, but still it ran two or three times, but having overturned itself, it was locked up in an arsenal as a dangerous thing and very luckily has been preserved and could to-day be very readily fitted for operation. Not only did Cugnot make the first steam-driven carriage, but he was also the first to drive a rotary shaft from a reciprocating piston, this being done by a ratchet and pawl arrangement which is clearly shown in the illustration.

Next in historical order we have the Murdoch, Fig. 2, made by William Murdoch as a small alcohol-driven model in 1784, and still preserved by his descendants. There is reason for believing that Murdoch also constructed a larger machine and that he ran it on the highway.

A small working model of a steam-driven carriage for common roads was also constructed by Richard Trevithick in 1800, but the history of the locomotive for use on rails begins with the Trevithick engine of 1804, shown in Fig. 3. This locomotive did actual service on the Merthyr-Tydvil tramway, in South Wales, in 1804—just an even century ago. In a letter dated that year Trevithick speaks of hauling 10 tons of iron and 5 "waggons" loaded with 70 people, the length of track being 9 miles and the speed 5 miles per hour. It will be seen that the engine is a geared machine and that it is fitted with a heavy flywheel, and the first great step forward in locomotive construction appears to have been the elimination of both these features which was done by Trevithick himself. The cars shown at the exhibition, and in this halftone, are the original cars sent from South Wales, and the same is true of the track and the stone sleepers on which the rails rest. We thus have here a portion of the first train to feel the draft and the first rails to feel the weight of a steam locomotive, together with a true reproduction of the locomotive itself. The reader will not fail to note that the wheels have no flanges, but that the rails are flanged externally, and we see here the origin of our 4 feet 8½ inch standard gage. The gage of this track, measured between the flanges, is 5 feet, and when the flanges were placed upon the wheels, the wheels being placed upon the same axles and the gage measured between the inside of the rails, it was reduced to the present standard. The rails are of cast iron and about 3 feet in length, spanning the distance between adjacent stone sleepers.

It should be said also that the track under all the locomotives and models shows the kind of track upon which they ran. In some cases the track is a reproduction and in others it is the original.

The valve gear of this locomotive consists simply of two tappets attached to the valve stem with an arm from the piston rod for reversing the position of the valve at the end of each stroke, that is the plug rod of Beighton invented in 1718. Such a gear is, of course, operative and it has the feature that it will drive the engine in one direction just as well as in the other. No reverse lever is shown and no doubt when the end of a run was reached and the engineer desired to reverse his engine, he climbed down from his place and reversed the position of the valve rod from whichever position he found it in, and then climbed back again ready for the return trip. It was some time before this form of valve gear was improved upon.

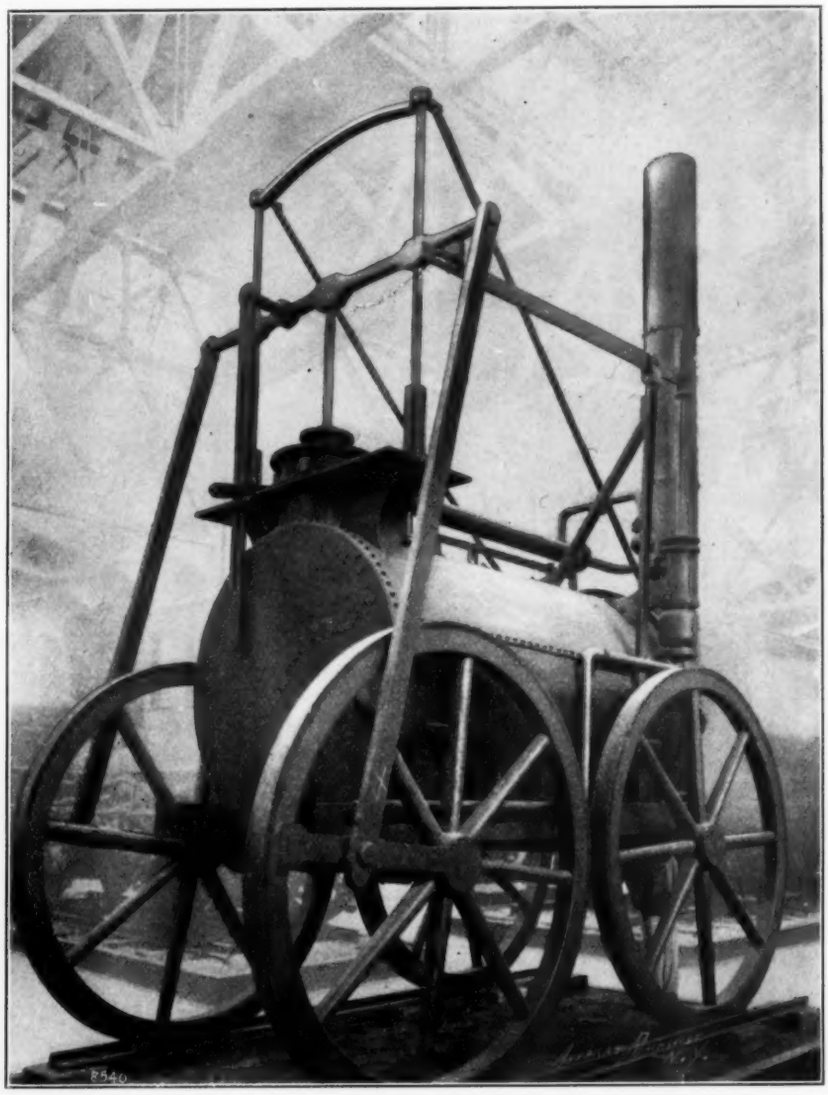


FIG. 4. THE CATCH-ME-WHO-CAN—1808.

Fig. 4 shows Trevithick's "Catch-me-who-can," which was exhibited in London in 1808 and in which we see that the flywheel and gears have disappeared. This was certainly a very elegant machine in comparison with many that followed it, and, according to Trevithick, it worked "exceedingly well." Its weight was 10 tons—about twice that of the "Rocket" of twenty years later. This proved too much for the track construction then available and the result was constant trouble. Finally the engine derailed itself and was abandoned. It proved to be Trevithick's final effort in locomotive construction, as he thereafter devoted his attention to high-pressure stationary engines exclusively. The reader will not fail to notice the large wheels which are 6 feet 6 inches diameter—far in excess of anything that had previously been thought of. The abandonment of the flywheel by Trevithick was final, as it never again reappeared, but the geared construction continued to be used for many years, Ross Winans having made geared locomotives as late as 1844.

It will be observed that the exhaust of this engine is discharged into the stack, and it is claimed by Trevithick's descend-

ants that he understood the value of this device as a means of increasing the draft. Whether or not that is so, the value of the arrangement seems to have been lost sight of by future constructors. By tracing the arrangement of the pipes and their connection with the pump and boiler, it will be seen also that this engine was fitted with a feed water heater.

Fig. 5 shows the Blenkensop of 1811, by Mathew Murray and John Blenkensop, the former being the designer. In this we see a distinct retrogression in the introduction of a rack rail and cog wheel, but these features but illustrate the universal skepticism of that time regarding the sufficiency of the adhesion of the wheels to the rails to do much useful work, and, indeed, the adhesion of the wheels to the rails is *the* marvel of the locomotive. In another respect, however, this engine was an important advance, as it appears to have been the first to employ two cylinders connected to cranks at right angles and thus be able to start from any position. The reproduction at St. Louis does not show these cranks at right angles, but this is obviously an error in assembling. Several of these engines were built and used at the Middleton Colliery Tramway, near Leeds, England, and were thus the first to be put to actual commercial use.

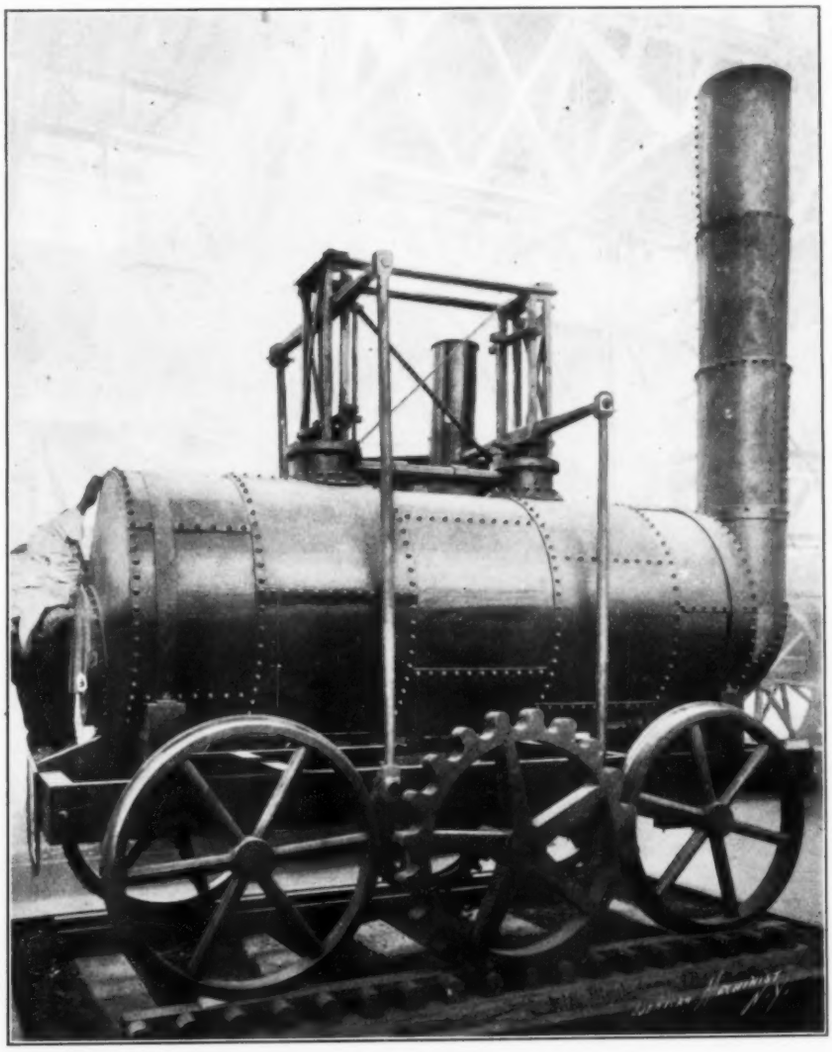


FIG. 5. THE BLENKENSOP—1811. THE FIRST TO HAVE TWO CYLINDERS WITH CRANKS AT RIGHT ANGLES.

As has been said, and in spite of Trevithick's demonstrations, there was a great amount of skepticism regarding the sufficiency of the adhesion of the wheels to the rails for purposes of haulage, and an engine with grasshopper legs behind for pushing it over the track, was constructed to overcome this supposed difficulty. In 1812 Wm. Hedley, of England, constructed an experimental machine, shown in Fig. 6, for definitely settling this question. The original of this machine is still preserved in the South Kensington Museum, and of it this one is a correct reproduction. By means of cranks and gearing, the truck was propelled by muscular power. By loading the truck with various weights, and by varying the weight on and the number of cars behind it, definite relations were established between the weight of the locomotive and the weight of the load which it would haul. The model was, of course, rough and crude, as it had to be, but it was as truly scientific in its spirit as is the great Pennsylvania testing plant in operation at the other end of the building in which this reproduction stands.

Following his demonstration by means of this model, Hedley proceeded to construct the "Puffing Billy" in 1813. The original of the "Puffing Billy" is now in the South Kensington Museum; it is the oldest actual locomotive now in existence, and of it the model on exhibition at St. Louis, shown in Fig. 7, is a reproduction. Comparing this engine with Trevithick's elegant 1808 model, it certainly seems a long step backward as regards simplicity, but there was method behind it all.

The "Blenkensop" had a shaft for each cylinder with two cranks to each shaft and a geared connection between the shafts to preserve the right angle relation, but the "Puffing Billy" had but one crankshaft of which each cylinder drove one end. This is the essential principle of the modern locomotive which, tho in disguised form, is thus beginning to show itself. The "Puffing Billy" retained the plug rod valve gear. In connection with the testing machine it represents the beginning of true engineering in locomotive construction. Hedley could tell beforehand what load his engine would haul, and he could design an engine to haul a given load. It is not probable, however, that he could predict the speed.

The next engine in chronological order, at least as far as shown by this exhibition, is the "Blucher," Fig. 8, which was George Stephenson's first and which dates from 1814. Here again we see the two cylinders with cranks arranged to give a right-angle effect, but the arrangement is a distinct retrogression from that of the "Puffing Billy." The two crankshafts are connected by gearing, both to the driving shafts and to one another, so that the right angle adjustment is permanent, the arrangement being essentially that of the "Blenkensop" but with the crankshafts geared to smooth faced driving wheels instead of to a cog wheel. In another respect the "Blucher" was, however, a distinct advance, as, so far at least as this exhibition shows, it was the first locomotive to use the eccentric as a means of driving the valve. There is but one eccentric for each cylinder, and the method of reversing the engine is not obvious. For this purpose the eccentric may have been loose upon the shaft between lugs which limited the motion in each direction. F. A. H.

There is a defect of vision which is called chromic—not chronic—myopia. It is that of persons who can distinguish colors at a short distance but not far off. In railroad service this defect becomes of considerable importance in the case of employees operating high-speed trains, and testing eyes by colored yarns in a room does not reveal its presence.

Theories of Journal Lubrication.

From the closing portion of a paper on the "Results of Physical Science in Modern Practical Mechanics," presented by A. Sommerfeld at a meeting of German scientists and physicians in Kassel and printed by the *Zeitschrift des Vereines deutscher Ingenieure*, we translate as follows:

In regard to friction we have two diametrically opposite theories: one that of dry friction exploited by Coulomb . . . and the other that of fluid friction, which in its simplest form was expressed by Newton.

In practical mechanics the first theory so far dominates that it is applied even to bearing friction, where the fluidity of the lubricant is indispensable. The amount of the friction-moment is commonly, therefore, in agreement with the law of dry friction, made proportional to the journal pressure, or, more accurately speaking, equal to a coefficient of friction times the journal radius times the journal pressure. Thus the coefficient of friction is an empirical number to be determined by experiments upon the bearing at the particular speed and load.

The theory of fluid friction was first applied to bearings by the Russian investigator, Petroff. According to this theory the entire frictional work takes place in the interior of the lubricant and virtually consists in a mutual displacement of the individual layers of lubricant comprehended between the journal and box. Ac-

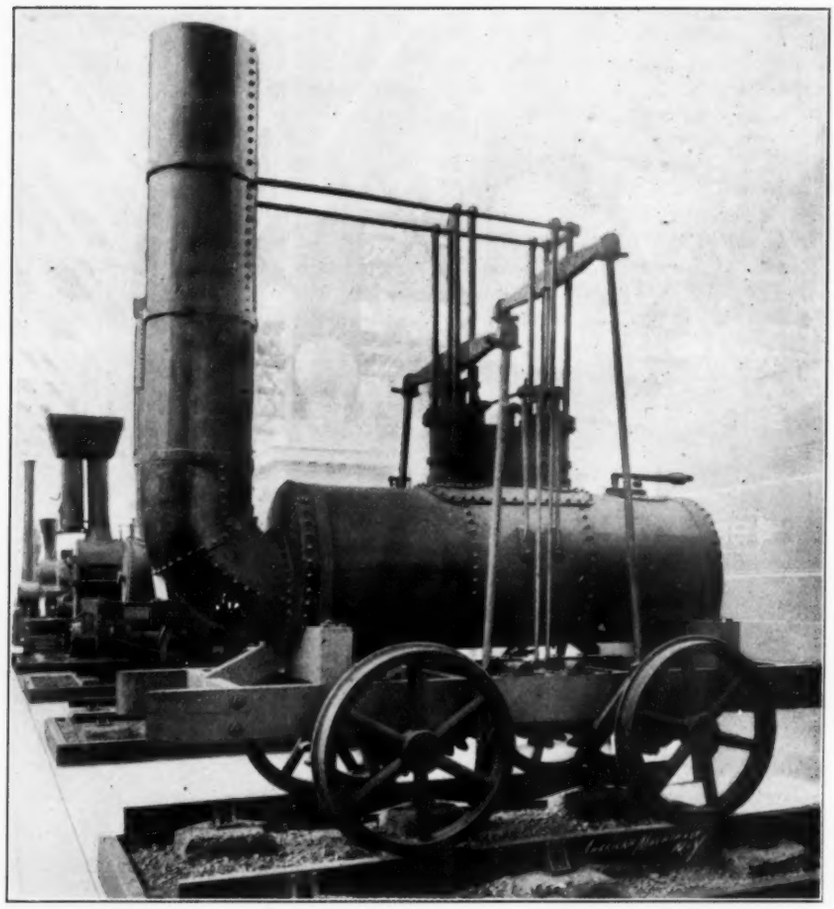


FIG. 8. THE BLUCHER—1814. THE FIRST TO HAVE VALVES DRIVEN BY ECCENTRICS.

FIG. 6. THE FIRST LOCOMOTIVE TESTING PLANT—1812.

cording to this conception, the frictional moment should, in the case a truly concentric journal and box, be considered proportional to the rotary speed of the journal and independent of the journal pressure; and into the factor of proportionality enters the constant of the internal friction of the lubricant, as well as the measurements of the bearing. Again, it was Osborne Reynolds who further developed and refined the hydro-dynamic theory of bearing friction, in that he discarded the assumption of a central position of the journal, and, moreover, determined this position from the requirement that the hydro-dynamic frictional effect and pressure on the journal should balance the external pressure thereon.

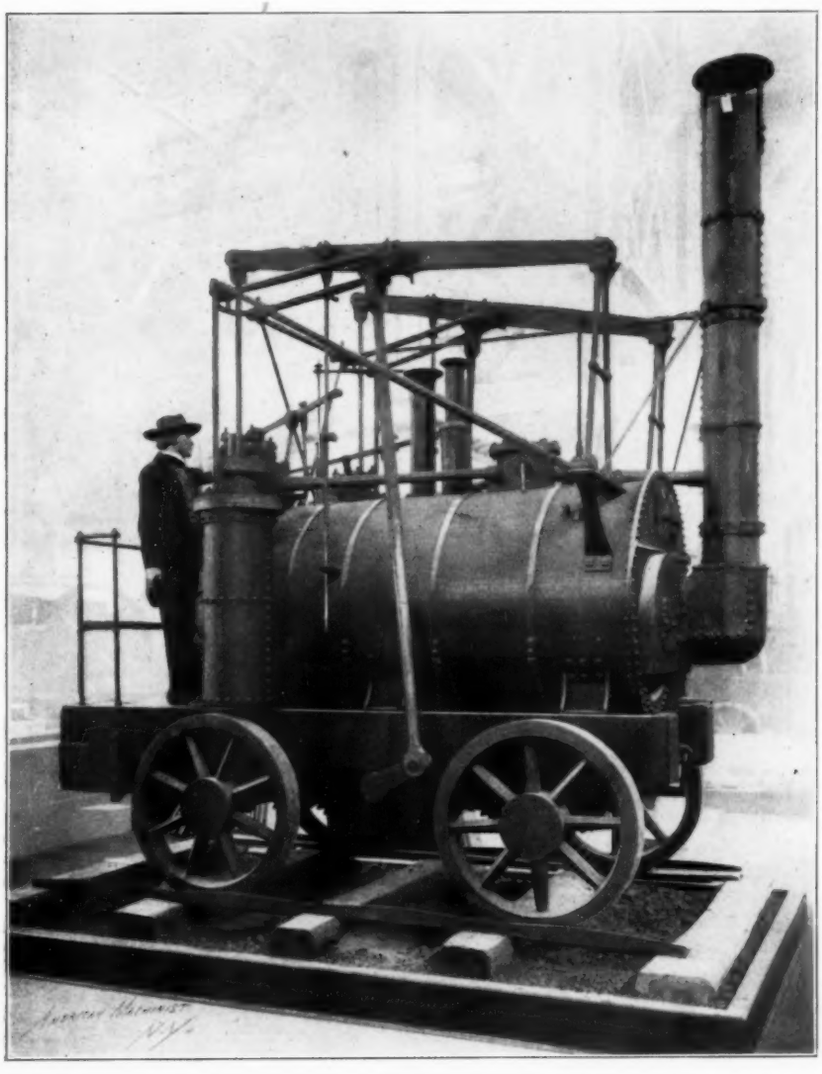


FIG. 7. THE PUFFING BILLY. THE FIRST TO HAVE TWO CYLINDERS CONNECTED AT RIGHT ANGLES TO ONE SHAFT.

What does experience say to one or the other theory? Speaking in an entirely general way, the answer is as follows: For slow speeds or high loading the amount of journal pressure is influential; for high speeds or relatively small loads the frictional moment becomes independent of the journal pressure. In the first case the theory of dry friction appears to hold; in the second case the condition approximates that which might be expected with a concentric journal according to the theory of fluid friction.

In recent times an extensive series of experiments on bearing friction has been made by Stribeck,* which I may compare with theoretical considerations. Resting on the ground of pure hydrodynamic theory and extending and simplifying the Reynolds calculations, I can, to a certain extent, bridge the gulf between dry and fluid friction theories. It is to be observed that the hydrodynamic theory, in the limiting region of high velocities, gives us the simple Petroff theory, while in the region of sufficiently low velocities it gives an expression for the frictional moment which coincides with the formula—coefficient of friction × journal radius × journal pressure. In this expression the value of the coefficient of friction for sufficiently low velocities (the "friction coefficient of rest," as we might say) is a simple function of the bearing dimensions and independent of the amount of journal pressure, as well as of the nature of the lubricant.

Concerning this relation for medium velocities, the following may be said: For each load there is a certain favorable velocity at which the frictional moment is a minimum. The theoretical position of this minimum, as regards dependence on the journal pressure, on the internal friction constant, etc., agrees excellently with the observations of Stribeck.

I may indicate one further point. According to the notion of dry friction, the journal must lie on a point of the bearing which is displaced relatively to the direction of journal pressure in a direction opposite to that of revolution. According to the hydrodynamic theory, on the contrary, the place of closest proximity of journal and box and the place of greatest hydraulic pressure is displaced relatively to the direction of journal pressure in the same direction as the revolution. There were made last spring [1903], at my suggestion, by Hrn. Architect Becker, in the Witten railroad shops, observations of the surface and wear of bearings of locomotives sent there for repair. Among twenty boxes suitable for investigation sixteen showed the place of bearing to be forward in the direction of revolution, as above said; in only two it was the opposite, behind, while the remaining two showed no displacement. Apparently this little statistical contribution confirms the hydrodynamic theory, at least qualitatively, in quite a remarkable manner.

Quantitively, it is true, we are still very much in the dark, and can be enlightened only by coincident experimental and theoretical investigation. There is no doubt that in regard to bearing friction the practical engineer remains in favor of the experimental side; but in this case, as in general, a theoretical comprehension of the problem will be of assistance to him.

*Zeitschrift des Vereines deutscher Ingenieure, 1902, p. 341, and Mitteilungen ueber Forschungsarbeiten, Vol. 7.

A correspondent describes an incident which occurred when an acquaintance showed him a micrometer caliper that was admired on account of its simplicity. The maker, on being asked how he produced the screw with sufficient accuracy, replied, "The screw is nothing marvelous, but the vernier gets over that," meaning of course that whatever errors there might be in the screw were corrected by the vernier. Our readers who know anything of the principles involved in micrometer screw measurements will readily understand about how competent such a man would be to make a micrometer that could be depended upon. He simply failed to in the least comprehend the basic principles upon which a micrometer is based, and that no vernier or other refined means of reading small angular movements of screws will compensate for errors of pitch in the screw itself.

Experiments with a Lathe-Tool Dynamometer —II.*

EXPERIMENTS ON DURABILITY OF DIFFERENT CUTTING ANGLES.

All the preceding trials were made in the endeavor to determine the laws of the variation of *cutting force* with tool-angle and with shape of cut. It was, however, *a priori* to be expected that the tool-angle which gave the smallest cutting force would also prove the most durable or remove the greatest weight of material before failure. As this is a point of even greater practical importance than the other, two further series of trials were projected, one on the soft steel, the other with the medium gray iron, for the purpose of finding the cutting angle to be recommended for shop use.

In the gray-iron series a cutting speed of 44 feet per minute, with a cut 3-16 inch deep by 1-16 inch traverse, was decided upon, after about fifteen preliminary trials had been made. It was found in these preliminary experiments that a foot per minute, more or less, in the cutting speed made a great difference in the duration of the experiment; and, as time and material had to be economized, the careful adjustment of the speed was necessary to ensure uniform and consistent results. Cutting angles of less than 60 degrees were excluded, but it was decided to use tools of 60, 65, 70, 75, 80, 85 and 90 degrees cutting angles, and to run them at *exactly* the above speed until they failed.

The times of failure or durations of these runs are plotted as ordinates on a

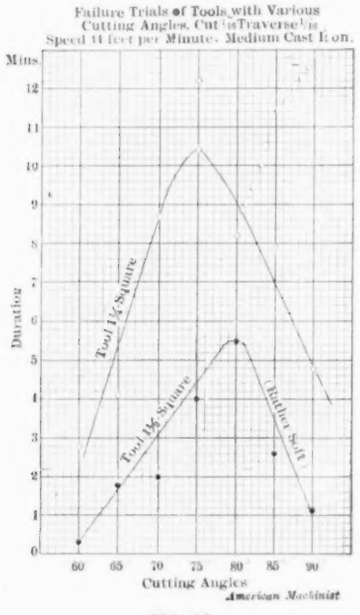

Failure Trials of Tools with Various Cutting Angles. Cut ⅛ Traverse 1/16
Speed 44 feet per Minute. Medium Cast Iron.
Mins.
Duration
Tool 1½ Square
Tool 1¼ Square
Rather Soft
60 65 70 75 80 85 90
Cutting Angles
American Machinist

FIG. 20.

base of tool-angles in Fig. 20. A cutting angle of from 75 to 80 degrees with tools of 45 degrees plan angle was the most durable for medium gray iron. As the cut (3-16 inch) was somewhat shallow, and the tool point had a small radius (about 3-32 inch) in plan, the shaving moved off in a direction nearly perpendicular to the axis of the work, instead of at right angles to the cutting edge of the tool (45 degrees in plan). This means that the actual cutting angle, measured in the direction of motion of the shaving,

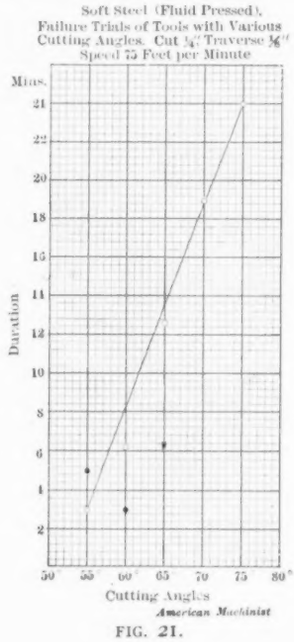

Soft Steel (Fluid Pressed).
Failure Trials of Tools with Various Cutting Angles. Cut ¼" Traverse 3/8"
Speed 75 Feet per Minute
Mins.
Duration
50 55 60 65 70 75 80°
Cutting Angles
American Machinist

FIG. 21.

(in plan) [or the true cutting angle as per Manchester Report] was about 81 degrees. Tools should therefore be ground for maximum endurance in the cutting of gray iron in ordinary shop practise, so that their true cutting angles are about 81 degrees, or if they are allowed 6 degrees clearance for working on the level of lathe centers, they should have an included angle of about 75 degrees.

The series of trials made to determine the most durable angle of tool for the rapid cutting of steel had to be run at a speed of 75 feet per minute, in order to secure failure in a reasonable time on the cut of ¼ inch by ⅛ inch, which had been decided upon. Unfortunately, the soft-steel shaft supplied by Messrs. Whitworth (originally 22 inches diameter and 9 feet long) was, by the time the trials now referred to were commenced, reduced to a diameter of less than 6 inches in parts, and the vibration which sometimes ensued, together with the difficulty of getting sufficient length of parallel bar for a failure trial, prevented the series from giving a quite conclusive result with regard to soft steel. Fig. 21 shows the nature of the results obtained.

A further series of trials to determine the most durable cutting angle of tool for steel was carried out with the remainder of the bar of *medium* fluid-pressed steel used in the Manchester Committee's experiments.

The trials above reported with the *soft steel* bar proved inconclusive in their results, as the bar had become so reduced in diameter that a run of duration sufficient to fail a tool was with difficulty attainable, and excessive springing of the work and chattering of the tool took place. The medium steel bar had, however, still a diameter of 12 or 13 inches, and its length allowed of long runs being taken. Two series were made, one at 74 feet per minute, the other at 73 feet per minute, cutting speeds; the cut in both cases being ¼ inch deep and ⅛ inch wide. The results obtained are plotted in Fig. 22, the durations of the various trials being set up on a base of cutting angles of the tools employed. Taken altogether these trials seem to show that a cutting angle of about 70 degrees (included angle 65 degrees) is that which will last the longest in rapid cutting. The plan angle of the cutting edge was 45 degrees throughout.

EXPERIMENTS WITH UNIVERSAL DYNAMOMETER.

In the trials with the second or universal form of dynamometer, in which the thrusts in both horizontal directions, as well as in the vertical direction, were measured, one series was projected in which all the tools were to have the same cutting angle, viz., 55 degrees, but four different plan angles of the cutting edge, viz., 22½, 45, 67½ and 90 degrees. In the other series a common plan angle of 45 degrees was to be preserved, with cutting angles of either 45, 60, 75 or 90 degrees.

The observations obtained in these two series of experiments (Schedules *A*, *B* and *C*) with the second or universal type of dynamometer give the three compon-

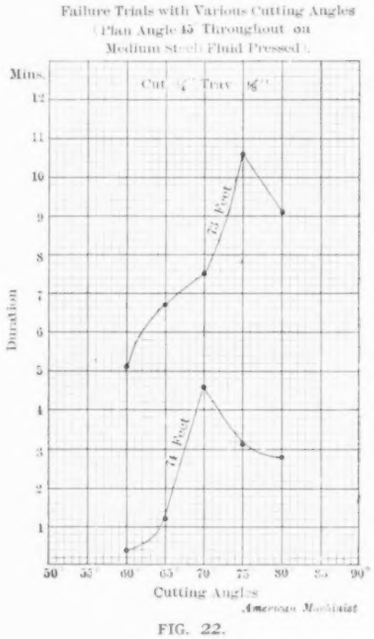


FIG. 22.

ents of the total thrust of the work on the tool point, viz.: the force acting vertically downwards (*V*), the force acting horizontally, parallel to the axis of the work and tending to thrust the tool to the right, or draw it in to the left (*T* or — *T*), and the horizontal force acting perpendicularly to the center line of the work

* Abstract of a paper by J. T. Nicolson, presented at the Chicago joint meeting of the American Society of Mechanical Engineers and the Institution (British) of Mechanical Engineers.

which tends to thrust the tool backwards (S).

The knowledge of these three components enables the magnitude and direction of the resultant force (R) to be determined. Fig. 9 represents the tool and cut in plan, $a\ b$ being the cutting edge,

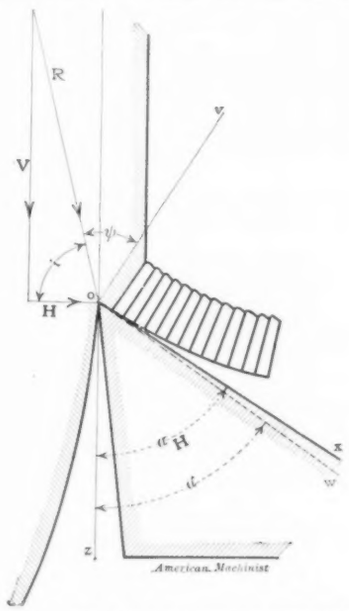


FIG. 8. DIAGRAM OF CUTTING OPERATION.

$c\ d\ b\ f$ the edge of the work in section, $d\ b\ e\ d^1\ d$ the section of the cutting which is in course of removal. The actual point of application of R is of course unknown, but will be taken for convenience at a point o on the cutting edge midway between d and b. The lines $d\ h$ and $b\ g$ represent the direction of motion of the removed shaving, which, for deep cuts, was found to be perpendicular to $a\ b$.

From o draw T and S equal to the

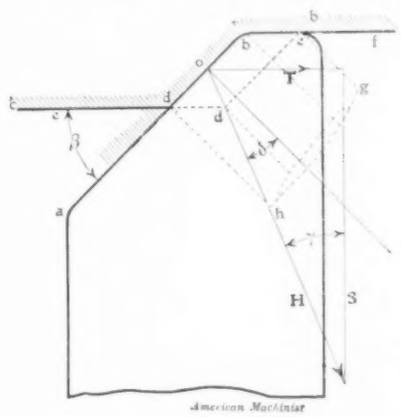


FIG. 9. PLAN OF CUTTING TOOL.

traversing and surfacing forces (as above described); then the resultant of these two forces (H) (acting at the angle γ to S) is the total horizontal component of resultant R.

Obviously:

$$\frac{T}{S} = \text{tan. } \gamma, \text{ and } H = S\sqrt{1 + \text{tan.}^2\,\gamma};$$

thus H and γ are known.

If we denote the plan angle of the cutting edge by β, and the angle made by H with the direction of motion of the cutting (*i. e.*, the perpendicular to $a\ b$) by δ, we have also $\delta = \beta - \gamma$.

Referring now to Fig. 8, which shows a vertical section of tool and work in the plane containing H (and R), the real cutting angle of the tool, called α, is shown dotted by $z\ a\ w$, while the angle $z\ o\ x$, called α_H is the cutting angle measured in the direction of the force H. Let ψ be the angle between the force R and $o\ v$ perpendicular to $o\ x$. Then, drawing V and H as shown, we have:

$$\frac{V}{H} = \text{tan. } (180 - \overline{\alpha_H + \psi}) = \text{tan. } i, \text{ say,}$$

where $i = 180 - (\alpha_H + \psi)$, is the inclination of R to the horizontal; and $R = H\sqrt{1 + \text{tan.}^2\, i}$. Also tan. $\alpha_H = \dfrac{\text{tan. } \alpha}{\cos. \delta}$; so that α_H and ψ are known.

Certain of the results have been selected for graphic representation in Figs. 23, 24, 25, 26 and 27. Fig. 23 depicts the variation of the surfacing and traversing forces, expressed as percentages of the vertical force with the different plan-angles of tools employed, viz., 22½, 45, 67½ and 90 degrees. [This angle is shown and called β in Fig. 9 and Fig. 27.] We see that the traversing force ratio varies but little and irregularly, and is of smaller importance than the surfacing force.

The surfacing force ratio is seen to have its smallest values for tools with a plan-angle of 45 degrees (the cutting angle being 55 degrees). This minimum varies from 33 per cent. of V for light cuts to 18 per cent. of V for heavy cuts. On the other hand, the percentage sometimes rises to nearly 40 per cent.

In Fig. 24 curves have been drawn showing the variations of the same percentages

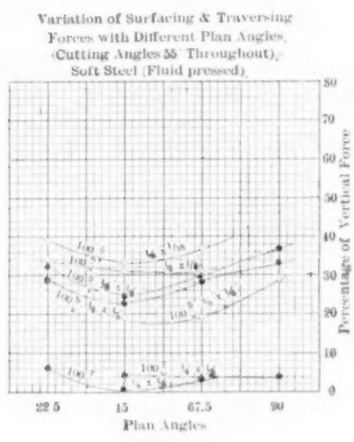


FIG. 23

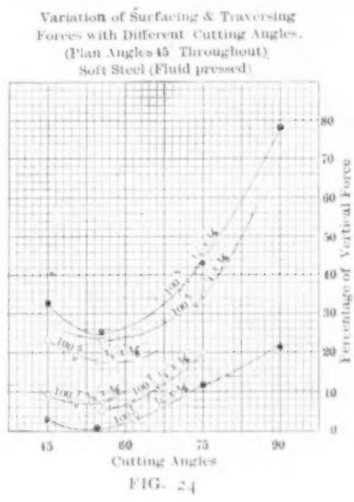


FIG. 24

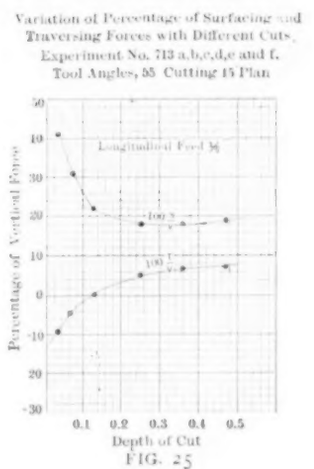


FIG. 25

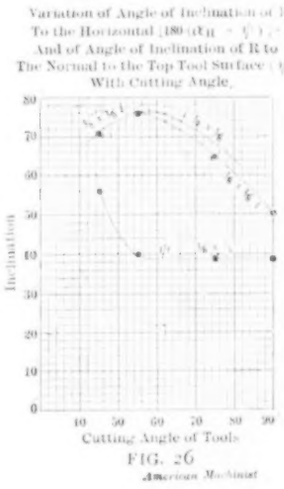


FIG. 26

American Machinist

with tools of different cutting angles, all the tools being ground with a 45-degree plan-angle.

Both the T/V and S/V ratios are seen to pass through minimum values in the neighborhood of 55 degrees. The minimum values of the percentage ratio of surfacing to vertical force vary from 25 per cent. for light to 18 per cent. for heavier cuts. With a right angle for the cutting angle and for light cuts this ratio may attain 80 per cent. of V. T/V is again not so important as S/V, but it may reach 20 per cent. with obtuse cutting angles. It is curious to observe that while S/V diminishes as the cut gets heavier, the reverse takes place with T/V. This is clearly shown in Fig. 25, where the results of experiments made

with a single tool are plotted for different depths of cut from 1-32 inch by ⅛ inch to ½ inch by ⅛ inch (tool 45 degrees plan, 55 degrees cutting angle).

Fig. 26 shows how (i), the angle of inclination of R to the horizontal, alters with tools of different cutting angles (plan angle 45 degrees). It also shows how the angle of inclination (ψ) of R to the normal face of the tool is affected by changing the value of the cutting angle.

The inclination of R to the perpendicular to the tool face (ψ) is remarkably constant for all tools except the keenest. It does not vary by more than one degree for tools of 55, 75 and 90 degrees cutting angle, the average value for these being about 39 degrees.

The angle $i = [180 - (\alpha_{II} + \psi)]$ at first increases and then diminishes as the cutting angle gets more acute. It attains a maximum value of 78 degrees at a cutting angle of 55 degrees, at which V, T/V and S/V are a minimum. Fig. 27 shows some of these variations in a more realistic manner. The lower and upper views are of the same kind as already described in Figs. 8 and 19.

For two of the tests the lathe was turned round at a cutting speed of about 1 foot in 5 hours, by means of a wire rope made fast round the large cone pulley and hauled upon by a man operating a winch. A pointer about 5 feet long was clamped upon the forging, and the four dynamometer gages were read at every half an inch of motion of the end of this pointer *i. e.*, at about six one-hundredths (0.0625) of an inch of the cut. The vertical force varies from 9,080 to 8,920 every three-eighths of an inch of motion of the tool, the same wave length characterizing the variation of the surfacing and traversing forces. The observations have been plotted in Fig. 28 on a base of actual relative tool motion.

A similar experiment carried out with the first dynamometer is shown in Fig. 29. Here the cut was heavier, ⅜ by ¼ inch, and the tool had a 45-degree plan and 60-degrees cutting angle. The wave length of the force is about 0.6 inch for this experiment, and it varies between 13,000 and 8,000 pounds. It will be observed that the force attains a maximum soon after the cutting commences to crack or shear across and that it drops to a minimum when the small piece of cutting falls off the forging. At such a slow speed as this the cutting has time to shear off right across in separate fragments, whereas it forms a continuous curl of considerable rigidity when the cutting speed is higher than a few feet per minute. These fragments measured in this experiment about ¼ inch across the widest part of their surface next the top of the tool in the direction of motion.

Experiments show a constantly diminishing cutting stress as the speed increases up to 84 feet per minute, notwithstanding the fact that the same tool was used upon the whole series of cuts without regrinding. The results of these trials are shown graphically in Fig. 30. When running 84 feet per minute, the tool was removing

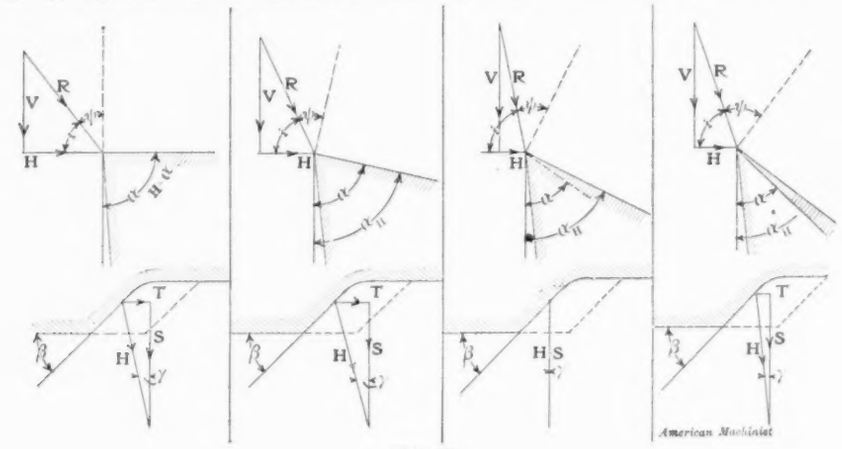


FIG. 27.

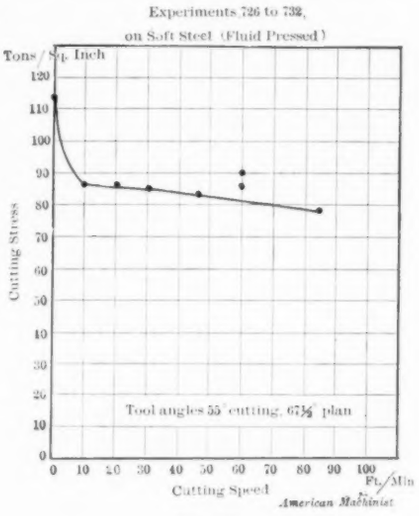


FIG. 30.

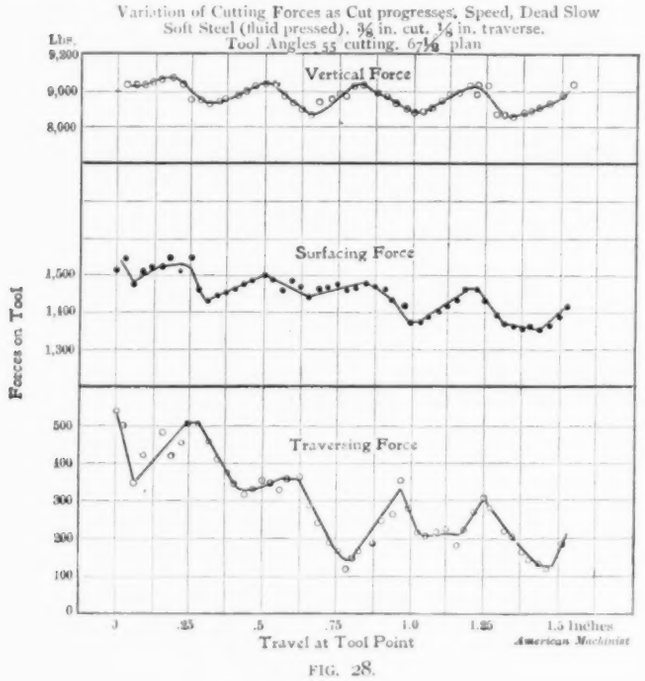

Variation of Cutting Forces as Cut progresses. Speed, Dead Slow
Soft Steel (fluid pressed). ⅜ in. cut. ¼ in. traverse.
Tool Angles 55° cutting. 67½° plan
Lbs.
Vertical Force
Surfacing Force
Traversing Force
Forces on Tool
Travel at Tool Point
American Machinist

FIG. 28.

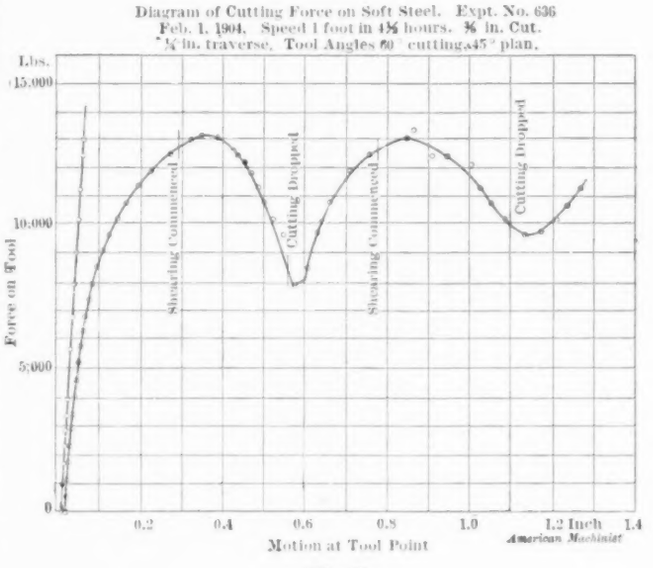


Diagram of Cutting Force on Soft Steel. Expt. No. 636
Feb. 1, 1904. Speed 1 foot in 4½ hours. ⅜ in. Cut.
¼ in. traverse. Tool Angles 60° cutting, 45° plan.
Lbs.
Shearing Commenced
Cutting Dropped
Shearing Commenced
Cutting Dropped
Force on Tool
Motion at Tool Point
American Machinist

FIG. 29.

material at the rate of 12.3 pounds per minute; but failure ensued in 1 minute 12 seconds.

Alloy Steels.*

BY WILLIAM METCALF.

The term "alloy steels" is used chiefly to distinguish steels containing influencing quantities of metals other than iron from the ordinary steel of commerce known as carbon steel, in which iron and carbon are the influencing elements for use, other elements being considered more as impurities than as useful ingredients. There are three kinds of carbon steel of universal use—namely, crucible, Bessemer and open hearth. Their discussion does not belong properly to our subject, but it may be observed that they contain small quantities of phosphorus, sulfur, silicon and manganese, as well as oxygen, nitrogen and hydrogen. Copper and arsenic are present sometimes, but not so generally or in such quantity as to require the careful analyses that are necessary for other ingredients. Certain small percentages of silicon and of manganese are often regarded as useful for special purposes, but not in such quanties as to justify their giving any specific name to the steel.

From time to time we have put upon the market silicon steel, phosphorus steel, chrome steel, aluminum steel, none of which have won any permanent place in commerce. Of permanent alloy steels, we have nickel steel, manganese steel, self-hardening or air hardening steel, and the latest, the new variety called high-speed steel.

Nickel steel, containing comparatively small percentages of nickel, is used chiefly for structural purposes, giving increased strength and toughness. It has been applied mostly to armor plates and gun parts, and lately it is being tested largely in rails to determine whether the increase in durability in difficult places will justify the greater cost over ordinary Bessemer or open-hearth rails.

Hadfield's manganese steel is unique. Hard, tough, non-magnetic, non-hardening by quenching, non-annealable by any known method, practically unmachineable; it stands by itself, there is nothing to compare it to nor to test it by. It is finding large use for a number of special purposes.

Self-hardening or air-hardening steel derives its name from the fact that when it is heated to an orange color and allowed to cool slowly in the air it becomes exceedingly hard. Some years ago it was known generally as Mushet steel, from the fact that its first development was due to the distinguished metallurgist whose name it bore. The usual composition of this steel is about 2 to 3 per cent. manganese, 4 to 6 per cent. tungsten, and carbon high.

The distinctive, persistent hardness of manganese steel indicates that it is manganese that gives this steel its so-called self-hardening property. This was confirmed many years ago by Langley, who found that steel high in carbon, containing about 4 per cent. tungsten and minute quantities of manganese, had no self-hardening property, and that the same steel remelted so as to contain 3 per cent. manganese, became an excellent self-hardening steel. Langley next showed by his beautiful emery-wheel test that tungsten is the element that acts as a mordant to hold the carbon in solution at a high temperature, giving this steel its most valuable property, that of remaining hard at a comparatively high temperature, so that a tool made of it could be used for cutting metals at a high speed, the tool continuing to do its work at a temperature caused by the enormous friction of the high speed, that would soften completely and render useless the best carbon steel tool that could be made. This very useful variety of steel has a large place in the markets, being used for many purposes where its peculiar properties give it great value. It is being rapidly overshadowed, however, by the latest and most surprising steel of all, known as high-speed steel.

Air hardening steel, as a rule, is not tough—that is to say, if it is made tough it will not be very hard. The edge of a tool will flow, and when it is so hard that it will not flow then it is so brittle that it will crumble easily, and this limits its usefulness. A few years ago, at the Bethlehem Steel Works, some person—whether he was a blunderer or a genius, history does not say—revolutionized the whole machine business. Either by design or accident he heated a tool made of air hardening steel until it was nearly melted, and according to the traditions and teachings of the ages the tool was ruined utterly. Again, either by accident or design, this "ruined" tool was put into service, and to the amazement of everybody it did an unheard-of amount of work. This led to further experiments and tests, and the Taylor-White process was developed.

This process consisted in heating a tool excessively hot and cooling it by successive stages, producing a tool that would cut at enormous speed for metal work, and take off chips that developed enough heat to blue them. The process was patented, and therefore it is not necessary to go into a long explanation here, especially as it has been superseded. The process seems to have been uncertain—that is to say, when a tool was handled just right it produced results that were wonderful, and when the manipulations were not exactly right the results were *nil*.

The potentialities were so great that nearly all of the leading steel makers in the world attacked the problem, with the result that the present high-speed steels are in no sense of the word air hardening. Manganese has been reduced from 3 to 4 per cent. to 0.30 per cent. to traces; tungsten has been increased to 10 to 20 per cent., instead of the usual 4 to 6 per cent., and the carbon is generally less than 1 per cent.

There are about 50 different brands on the market, and of course each one is the best. Perhaps the analyses of two of the leading brands will be interesting, as follows:

	Per cent.	Per cent.
Tungsten	9.99	18.48
Chrome	2.83	2.90
Carbon	0.69	0.78
Phosphorus	0.010	Not determined
Sulfur	0.010	Not determined
Silicon	Trace	Not determined
Manganese	Trace	0.33

Another contains the following:

	Per cent.
Molybdenum	9.65
Chromium	....
Carbon	0.66
Phosphorus	0.016
Silicon	0.046
Manganese	0.22

In one sense it is chaos. All traditions as to heating are completely reversed, and no one really knows what is the best. One brand is famous for its excellence in one kind of work, another in another kind, no one yet seeming to cover all of the ground.

One thing is certain, the machine business is revolutionized. These tools have crowded ordinary lathes, planers, drills, etc., away beyond their capacity; machine builders are remodeling their machines to meet the new conditions, and many of the users are throwing out their old machinery for the new, or else remodeling and strengthening what they have.

There are many records published of the work done by this steel, giving speed per minute, feed, depth of cut, etc. so that it is not necessary to repeat them here. A few illustrations of what can be done may be interesting.

In one case a couple of steel cast bed plates, about 4 feet wide and 9 feet long, were to be planed. There was nominally ½ inch to come off, but the unevenness of the casting made the cut about 1 inch in places. The surface was hard and gritty from the sand of the mold. Several tools were tried, each one going about ½ inch and then having to be reground. Next, one tool cut about 2 inches without grinding. Finally, a tool was tried that had turned up a large, rusty, gray iron pulley without grinding, and it cut clear across the bed plates and was still in good condition for further work. It is clear that the cost per pound of that tool cut no figure.

Another party had a great many castings to thread, with dies made of the very best carbon steel. He could at moderate speed thread from 2,000 to 3,000 pieces without grinding; with dies made of high-speed steel, and with his machine running as fast as he could drive it, he threads from 20,000 to 30,000 pieces without grinding. Another party turns many pieces of hard brasses. He found it difficult to get a tool that would cut them at all, until he tried the right high-speed

*Presented at the meeting of the American Society for Testing Materials, Atlantic City, N. J., June, 1904.

steel, and made a tool that would cut all day without grinding, running his lathes at the highest speed he could get. The same party bores many cast-iron cylinders, and with tools made of steel that would not cut his brass he bores eight to ten cylinders without regrinding, and at a speed so great that the cylinders came out too hot to be handled with the naked hand. He tried in his cylinders the steel that cut his brass so well, and it would bore only two to four cylinders without grinding.

Another party drills 2⅜-inch holes 7 inches deep in soft steel forgings, drilling a hole in about three minutes; the same steel will not make a good threading die for the same forgings, and for this he uses another brand. Neither of these steels will make a good lathe tool for turning these forgings, and for this work he uses a third brand.

All of these brands, upon analysis, would come within the limits of the analyses given above. From all of this two things are clear: One is that there has been a marvelous, a revolutionary, advance in the machining of metals; the other is that steel makers have met the demand remarkably.

It is also clear that we do not know yet where we are and there is much to be learned by everybody. The best methods of hardening may not have been found; it seems that for very high speed work it is necessary to fairly melt the point of a tool and quench it in a strong air blast, and then grind to shape. This would not do for threading dies, milling cutters, etc., for the heat would destroy the tools.

Such tools are finished from annealed bars; this high-speed steel can be annealed as nicely as carbon steel, differing in this respect from air-hardening steel.

The finished tools are heated in a lead bath of 1,800 to 2,000 degrees, and are quenched quickly in ordinary tempering oil, which must be kept cool by a coil containing circulating cold water; they are then tempered in a bath of heavy oil heated to about 450 degrees. The tools come out bright and clean and do their work wonderfully well.

The steel maker has the most to learn. He must find out why there is such a great difference in the work the steel will do, when there is so little difference in composition. He must find the composition or mixture that will come nearest to meeting all the requirements. He has at his command now ferromanganese, ferrosilicon, ferrochromium, ferrotungsten, ferromolybdenum, ferrovanadium and ferrotitanium. These alloys are all expensive, except the first two, costing from 60 cents to $12 a pound; therefore the present prices of high-speed steel, which to some people seem to be of the fancy order, are really not excessive.

As far as we know at present, the steel users have not succeeded in making tools that are satisfactory for finishing, and for this purpose they resort to tools of carbon steel, after having done the rougher, heavier work with high-speed steel. This difficulty may be overcome by proper methods of hardening and tempering, or the steel makers may find a composition that will make a tool that is as good for finishing as for roughing.

The successful production of the above named alloys marks a great advance in metallurgy, and, now that a demand has sprung up, it is certain that the supply will follow, with certainty and uniformity of composition and reductions of cost.

The making and the utilizing of steel containing practically only carbon and iron, with some modifications made by the use of small quantities of manganese, silicon, tungsten and nickel, have occupied the best minds in the manufacturing and engineering world for many years. The last half of the nineteenth century saw most wonderful developments produced by the inventions of Bessemer and Siemens, aided by the skill and energy of the brightest engineering minds. At the close of the century it was customary to "point with pride," and to assume that so much had been done and so much was known that there was no room for more revolutionary changes, and the coming generation had only to tag along, utilizing these great advances with ease and comfort to themselves and with blessings upon their predecessors.

Now, in the first five years of the twentieth century, we older men find ourselves standing on our heads once more. A revolution has come already, and we can look forward to a splendid opening for the exercise of the best energy and thought of the succeeding generation.

We enjoyed the struggle and the gains of our time, and we can rejoice with the younger men in the prospects of the great triumphs that are to come for them. Clearly, there is still plenty to do and plenty to learn, and in the doing of them there will be great pleasure.

Last summer the E. R. Thomas Motor Company sent a number of its foremen to visit the different factories throughout the country. They were instructed to make no attempt to obtain secret information, but to present their credentials at the office. Without a single exception they were cordially welcomed by the various officials and a free interchange of methods and ideas was had to the mutual advantage and profit of all concerned. This summer the Thomas plant has been thrown open to visitors. Among the latter last week were ten of the National Cash Register foremen, who spent the entire day examining the various fixtures and tools and discussing the various systems of construction. The Thomas plants were also recently visited by manufacturing representatives from England, Japan and China, and students from Columbia and Cornell colleges, and the "Teck" of Boston.—*Sewing Machine Times.*

A Water Tank Column Pattern.

BY JOSEPH HORNER.

Years ago I made a pattern of a fluted column, shown in Fig. 1, for a large order for water cranes. I should say that including subsequent orders considerably over a thousand castings have been made from that pattern. As it was made to last and to retain its shape permanently, a description of it may be of interest. The length was about 10 feet, and the fluted shaft measured about 8 inches diameter. At the foot the column fitted into recesses in a circular foot plate cast in segments; at the top a circular cap was fitted to receive the ends of girders on which the bottom of the water tank was carried. Some carving at the top of the capital is not indicated on account of the small scale of the drawing.

The basis or body of the pattern is hexagonal in section, of gray iron, *A*, Figs. 2 and 4, and for it a rough wooden pattern was made, with planing allowances. It runs parallel in section throughout, is as long as the complete pattern minus the end prints, has numerous cross-bars into which iron dowels are inserted, and is planed both along the joint edges, the cross-bars excepted, and on the outer six faces to receive the lagging strips and the capital and base which form the pattern proper. The ends were planed square and a center line was scribed across the ends for centering by in the lathe. The thickness of metal in the body of the pattern base was from ¼ to 5-16 inch—being variable because such castings do not come out of the mold quite straight.

On this base the various pieces are fitted in sectional lengths, as indicated in Fig. 1, comprising the main flutes of the shaft in one length *a*, the beadings *b b*, the capital *c*, the base *d*, and the core prints *B*, reference letters which are retained in subsequent figures. The fluted shaft and the capital are attached as lagging strips, the other parts solidly. The strips are of mahogany, the other sections of willow, because some of that, well seasoned, happened to be in stock, otherwise mahogany would have been used.

Having the centers on the ends of the iron base, all the parts were fitted before the column was put in the lathe. The lengths of each section, being squared across from the planed edges of the base *A* in the joint face and over the sides, served as guides to the fitting. The sectional views illustrate how this is done, these showing the finished pattern and not the roughly cut strips and blocks.

The fluted shaft is seen in section in Fig. 2, corresponding with the section *e e* in Fig. 1, the plain base section at *f f* in Fig. 1 is shown in Fig. 3. The section through the capital is the same as through *e e* but larger in diameter. Fig. 4 is given to illustrate the method of fastening the wooden sections of the capital to the iron center in the longitudinal direction, and is drawn through the capital, the bead, and the termination of the shaft flutes.

Similar fastenings are adopted for all the parts, the whole of which are left behind in the mold, after the withdrawal of the iron center *A*. Being then withdrawn in detail, they do not tear up the sand as the withdrawal of the pattern bodily would do. The long strips for the fluted shaft are made as shown in Fig. 5 with ends screwed on, to render the working of the flutes easier, which will be noted presently. Fig. 6 is an end view of one-half of Fig. 4, to show the fastening of the print at that end, the other end being similar.

The strips for the fluted portions are jointed at *g*, Fig. 2, not radially, but as much inclined to the horizontal as the fluting will permit, to facilitate delivery of the strips without risk of tearing the sand in the flutes, a point indicated in Fig. 2 by the dotted lines and the arrow. They are retained during the turning of the pattern and the ramming by thumbscrews *h*, with Whitworth threads, inserted at intervals, fitting plates tapped to suit sunk into the timber flush and retained there by screws. Wood screws going into the timber would soon become loose. Even these metal plates had their threads worn rapidly by the gritty sand, and had to be renewed occasionally.

The fluted shaft is necessarily fitted in six strips, Fig. 2, for delivery, but the base and the beadings are solid, the base being jointed and glued permanently as in Fig. 3. The prints *B*, fitted as solid blocks against the planed ends of the iron center, are bolted up securely, as shown in Figs. 4 and 6.

The pattern halves being united temporarily by stout center plates screwed on the ends of the prints *B*, the joint at the central portions being kept up close by dogs, the turning, the details of which need not be described, is done.

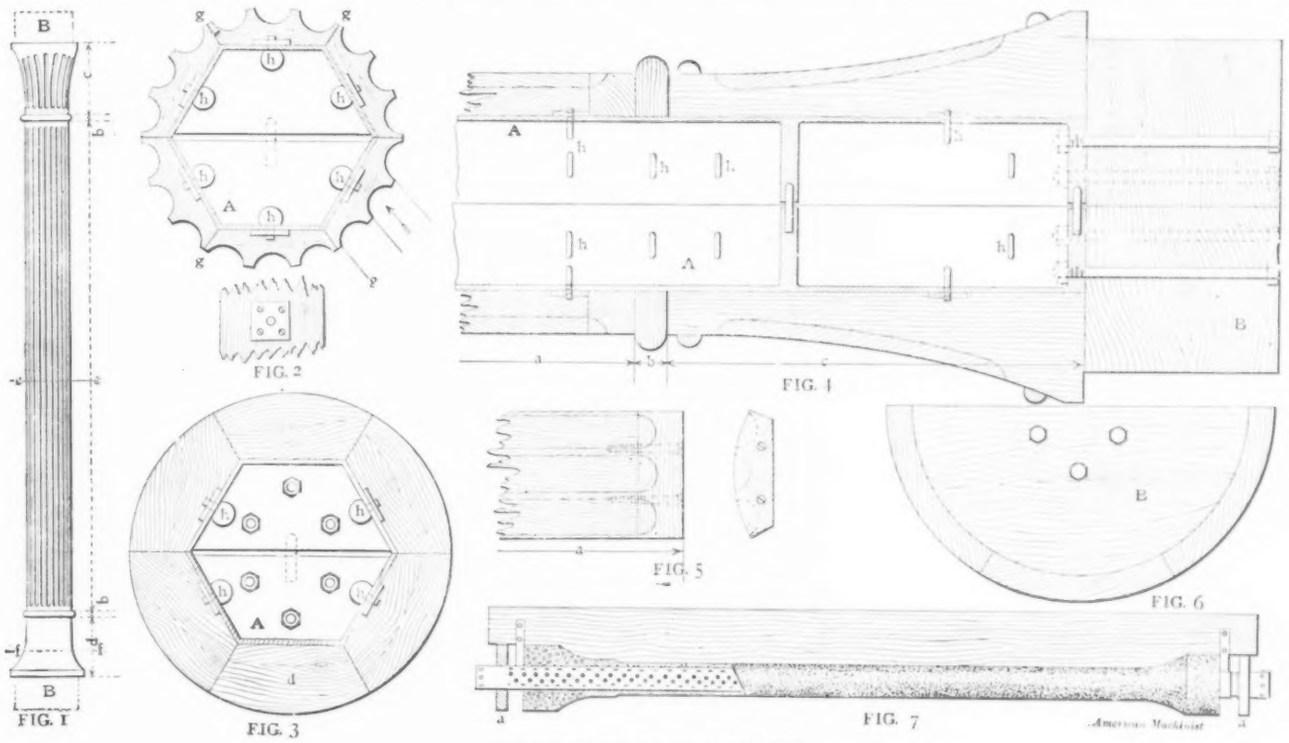
While the pattern remained in the lathe, the flutes were divided round and marked, and their edges scribed in deeply. Taking the pattern out and separating the halves, the strips were unscrewed from the interior and removed, and the flutes were worked. The use of the end pieces, Fig. 5, is now apparent, for when removed they leave a length of stuff in which the flutes can be worked from end to end with a round plane. When thus planed to templet the ends are replaced and glued and the semicircular terminations are cut with a gouge.

The flutes, and the ornamental edge on the cap, Figs. 1 and 4, were worked wholly with gouges. The little bosses there are glued on and nailed. The pattern after being sandpapered and varnished is complete. In this case blackleading followed the varnishing, making a beautifully glossy surface, most favorable to easy release from the sand.

The cores were swept on bars without hay bands on the body, these being used only at the enlarged ends. To avoid setting and measuring for the diameters of every core, turned iron collars *a a*, Fig. 7, were fitted over the turned ends of the core bars, these being of the exact diameter of the prints *B* at the ends of the column, thus ensuring that the ends of the core would fit the print impressions, while the shape and size of the board take charge of the remainder of the core.

The columns being only ⅜ inch thick at the bottom of the flutes, the core bars were drawn out through one end of the molding box soon after the metal was poured, the tow backing for the loam burning off.

To save all trouble and risk in setting the pattern and core, the holes in the ends of the molding boxes were bored to the exact diameter of the prints *B*, which took a bearing in the bored ends. The ends of the cores also lay in the print impressions, and took a bearing in the bored ends, being thus self-centering. The bars were of gray iron, and being large, little sag resulted, but chaplets were necessary both in bottom and top, near the central portions.



A WATER TANK COLUMN PATTERN.

The "Nipsic," one of the old wooden vessels of the navy, has been ordered out of commission at the Puget Sound Navy Yard, where she has been serving as a receiving ship. This marks the passing of one of the historic vessels of the old navy. The "Nipsic" was one of the few governmental-built vessels and almost the last wooden ship constructed for the navy. She was launched in Washington in 1879, having been six years under construction, and saw much service in all quarters of the world.

An amalgam, very convenient for stopping up holes that cannot be soldered easily, is made of the filings of an alloy of zink 66 per cent. and tin 34 per cent., kneaded with quicksilver in the hand into a stiff dough, squeezing out all the mercury possible. This amalgam should be pressed when first made into the cavity and allowed to harden. When hard it may be scraped or filed like the metal itself.

A Water Diviner and His Work.

BY H. SPENCER FLYNT.

The sinking of a number of artesian tube wells recently carried out at their works by Messrs. Meldrum Bros., Ltd., engineers at Timperley, near Manchester, England, and the fullfilment to the letter of certain prophecies made before an inch of ground was turned goes far to attest the genuineness, in this case at least, of the mysterious art of the "water diviner."

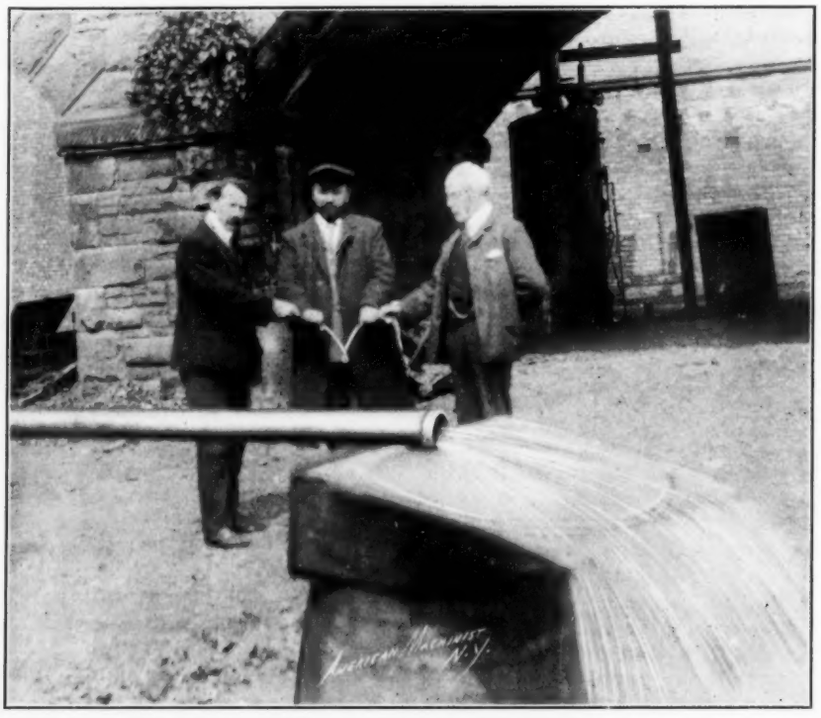


FIG. 1. TRYING TO STOP THE TWIG FROM TURNING.

Early in 1902, when commencing the erection of new works at Timperley, the directors engaged a professional water finder to test the site and offer an opinion as to whether a sufficient supply of water for the needs of the establishment could be obtained from wells and independently of other and more costly sources. While walking over the ground with his wand this gentleman indicated three spots, about a hundred yards apart, under which he said there were springs capable of yielding a continuous supply of water. No well-sinking contract was entered into in this case, however, but shortly afterwards it was decided to test the reliability of the mysterious practise of water divining by the engagement of a second expert. This gentleman, upon testing the ground with his forked twig or wand, and without any previous information to work upon, pointed out almost identically the same three spots as his competitor. At the same time in addition to giving an estimate, upon which the boring contract was based, of the depth of the streams below the surface and giving a guarantee respecting the volume of water per hour from each well, he offered the terms "No water, no pay." The wizard was Henry Chesterman, of 10 Cleveland place, Bath, whose portrait may be seen in Fig. 1, where Fred Meldrum (managing director of Messrs. Meldrum Bros., Ltd.) and the writer are endeavoring to prevent the twig from turning in his hands while standing over the subterranean stream.

FIG. 2. SHOWING TEST PUMP AND BORING TOOLS.

The terms named being calculated to inspire some confidence, Mr. Chesterman was allowed to undertake the work. At this time only the two smaller streams were tapped, and these he estimated at from 45 to 50 feet down and guaranteed 250 gallons per hour from each. The depths at which the streams were actually found were respectively 45 and 48 feet. The wells have been in almost continuous use ever since and to-day are each supplying 360 gallons per hour.

But perhaps the most remarkable of Mr. Chesterman's undertakings with which we have to deal was in connection with the boring of the third well within the last few weeks. In March last he tested the ground again and estimated the depth of the underground watercourse at about 95 feet and guaranteed a capacity of 600 gallons per hour, altho he said he expected this to reach 1,200 gallons per hour. Boring was commenced in the middle of April and after cutting through 7 feet running sand, 2 feet clay, 25 feet red sandstone, 18 inches red clay and greensand, 5½ feet gray sandstone, 16 feet red sandstone, 18 inches red clay and greensand, 20 feet red sandstone, 18 inches gray sandstone, 14 feet red sandstone, and a further 18 inches of clay, the stream sought was tapped at 94½ feet down, on May 5. The 6-inch steel artesian tubing was shortly after driven into the bore hole and the well was tested with a rotary hand pump. Exactly 1,200 gallons per hour were drawn without lowering the normal pumping level of the water in the tube. The rest level is 12 feet from the ground level and the pumping level 6 feet lower.

As these exploits caused Mr. Chesterman to become somewhat famous in the district, a few days after the testing of the well a number of interested persons gathered at the works, at the invitation of Messrs. Meldrum Bros., to witness a demonstration of water divining by the magician from Bath. Among the visitors were Mr. Willoughby L. Bayley, Amiee (gen-

eral manager) and several other departmental heads from the works of the Linotype Company, Ltd., Broadheath, together with other engineers of Manchester and the district, and some ladies. Having viewed the bore hole, the head of which, with the test pump and some of the boring implements, is shown in Fig. 3, Mr. Chesterman demonstrated to the company how he arrives at the depth of a stream below the surface of the ground. Approaching the stream alternately from each side he marks the spot over which the wand begins to turn. Thus he determines the width of the range of influence on the surface, and by a formula of his own he is from this datum enabled to calculate the depth of the same.

The most interesting part of the demonstration, however, was certainly that in which the power of Mr. Chesterman and his wand against a resisting force was tested. The two ends of the forked stick were held firmly in pincers by Mr. Meldrum and Mr. Bayley, one on each side of the operator. Mr. Chesterman then, with the remark, "Be sure you don't let it turn round," grasped the fork lower down, leaving the ends visible about 3 inches on each side of his hands, and moved forward along the invisible stream. He was closely watched, but not the slightest movement could be detected in his wrists or fingers, yet the point of the "V" made two revolutions around his hands.

At the conclusion of the demonstration several of the company who had not previously tried their hand with the divining rod were instructed how to hold it and taken across the zone of influence. None of them alone showed any indication of being "sensitives," but in several instances when Mr. Chesterman grasped the wrists of the novice, the stick evinced a decided inclination to twist.

Mr. Chesterman tells me that of his seven children six have inherited this strange faculty, it being most strongly marked in the youngest, a boy of 8½ years. With regard to himself, he says that on coming upon the stream with the wand in his hands, he experiences a sudden shock, which rapidly traverses his arms and seems to center in his heart; and so exhausting is this effect that he finds himself unable to use the wand for more than an hour or so each day. He has been practising his unique profession for thirty years, and during that time has found water and sunk numerous wells in different parts of the country. In one instance, curiously enough, he obtained a copious supply of water from an artesian well at the summit of a large hill, while the surrounding valleys were found to contain no subterranean streams of any magnitude.

FIG. 3. WELL DELIVERING 1,200 GALLONS PER HOUR.

A wand of hazel wood is usually considered the right kind to use, but Mr. Chesterman tells me that any twig with legs of uniform strength will serve the purpose. He has tested the virtue of a variety of substances, and the wand that he now commonly employs is made from a piece of 12 gage aluminum wire bent to imitate the form of the orthodox twig. In his thirty years' experience Mr. Chesterman confesses to having signally failed four times in his estimation of depth. He has met many individuals who have possessed the faculty without being previously aware of it, and has successfully trained several pupils.

Mr. Chesterman ascribes the phenomenon of water divining to the influence of electrical currents upon the nervous system of the "sensitive." Whether this is precisely the cause or not, the future evolution of much that is at present obscure in science may show. Be this as it may, it is nevertheless certain that, as we at present understand it, the faculty of water divining, when developed in a marked degree, is a valuable asset to its possessor.

Not to mention the places actually concerned, I would suggest, in conclusion, that it is a significant fact that in two cases in this district (which lies very low) where well-boring operations have been carried out under the reasonable supposition that if one bores deep enough in a flat land plenty of water must be found, the work has resulted so far in absolute failure. In one case the bore hole has been taken 165 feet down and in the other 250 feet. Still the water cometh not.

The Metric System in Australia—Decimal Coinage in England.

At the third annual meeting of the General Council of Chambers of Commerce of the Commonwealth, recently held in Melbourne, this subject was discussed with others, two resolutions being submitted. The first, "That the General Council of the Chambers of Commerce expresses its sympathy with the effort now being made by the House of Lords to introduce into Great Britain a metric system of weights and measures, and hopes that upon its acceptance at home an identical system may be adopted by the Commonwealth of Australia," was carried by a majority; while the second, "That this council expresses the hope that a decimal currency may very soon be introduced into England, and that the adoption by the Commonwealth of a similar system may at once follow," was agreed to without dissent.

The above, which we take from *Australasian Hardware and Machinery*, reminds us that Mr. Frank Cooper, who has charge of the machine tool business of Buck & Hickman, of London, and who formerly was an engineer in the service of the P. & O. Company, not only expresses himself in favor of the adoption of the metric system by Great Britain and as believing that it would be greatly to her advantage, but also expresses his belief that she should immediately abandon her cumbrous system of coinage and adopt a decimal coinage. He believes that her present system of farthings, pence, shillings, pounds and guineas is cumbrous and awkward for Britain's own people and seriously handicaps her in foreign trade. He believes that the adoption of both a decimal coinage and the metric system by Great Britain will eventually take place as a result of a general perception of their commercial advantages.

A man was advised by a friend to take a certain kind of pill for rheumatism.

"Pills!" he shouted. "Pills! I have taken so many pills already that my joints are all ball-bearing."

Letters From Practical Men.

Bender and Former for Jaws of Canopy Switches.

Editor American Machinist:

The accompanying sketches show the bender and former used for producing the jaws (or clips) which are used for canopy switches. The metal used was No. 14 B. & S. gage, half-hard sheet brass. The piercing and blanking die is not shown, this being an ordinary die for piercing the 3-16 inch holes and producing the blank as shown.

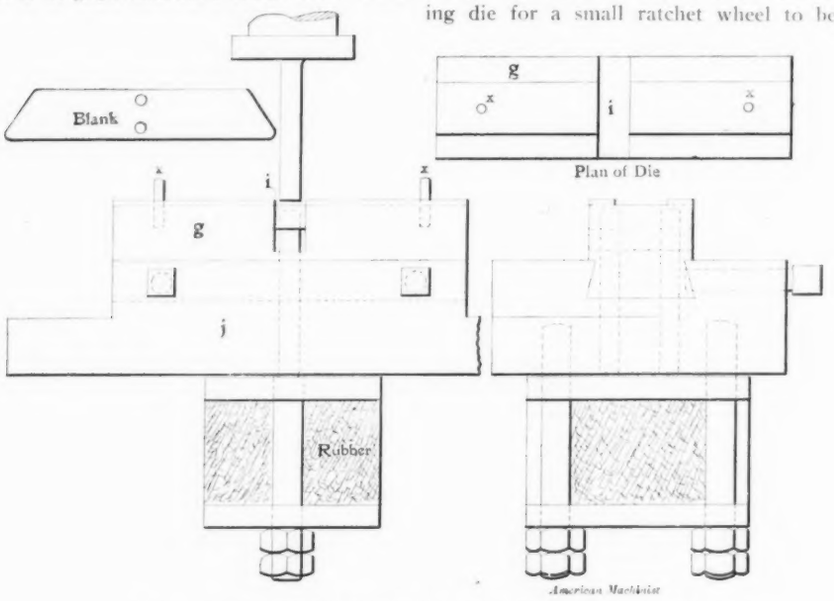


FIG. 1. FIRST BENDING OPERATION ON CANOPY SWITCH JAWS.

The first bending operation consists in placing the blank in the die *g*, Fig. 1, between the pins *x*, the blank resting on the pad *i* which holds the blank in the central position so that both sides will be of equal length. This operation was first tried without the pad *i*, but the result was not satisfactory, the trouble no doubt being caused by the variation in the thickness of the metal, which produced sides of unequal lengths. The tension produced by the pad and the rubber spring overcame this difficulty.

The blank being properly placed as described, the punch *h* descending causes the two sides to spring up and hug the punch which continues downward until the pad strikes the bottom, drawing the corners square and producing the shape shown at *W*, Fig. 2.

The die for the second or forming operation shown in Fig. 2 consists of the die *a*, the punch *b*, the center plate *c* and the guide pin *d*. All these parts are of tool steel hardened. *f* is the stop-pin in center plate *c*, and *e* is a gray-iron bolster. The die *a* and the punch *b* are made to the external shape of *Y*, the center plate *c* being made to the inside shape. The piece *W* is placed on center plate *c* to the stop-pin *f*; the plate is then placed in position in die *a*, the guide-pin *d* locating it properly. The punch *b*, descending, presses the piece *W* into die *a*, also over center plate *c*, producing the shape shown at *W'*, the finished jaw or clip.

WM. F. HOFFMANN.

Indexing Work in Shaper.

Editor American Machinist:

Fig. 1 in the illustration shows a blanking die for a small ratchet wheel to be stamped from steel 1-16 inch thick. The teeth required to be accurately spaced; so it would be a very tedious undertaking to lay out the job and file to the lines.

A much better way suggested itself, and is shown in Fig. 2, which represents the dividing head of a universal milling machine used in connection with the shaper. The die *a* was held in the three-jawed chuck and the depth of cut gaged by the reading of the dial *b*. The punch was milled in the milling machine, and altogether proved to be a very satisfactory job and quickly done.

An improvement over the old-style goose-neck tool usually used for inside work on the shaper is to replace the ordinary clapper with one about 1½ inches longer; bore a hole at *c* to take No. 5 Brown & Sharpe taper and use tools with shanks corresponding. Worn out end mills can often be forged to desired shape and utilized to good advantage.

C. HAMER.

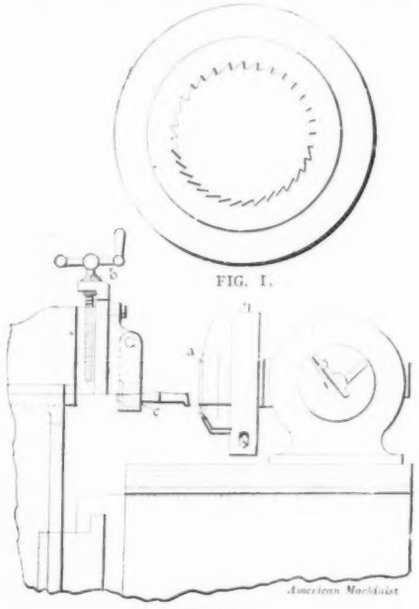


FIG. 2.
INDEXING WORK IN SHAPER.

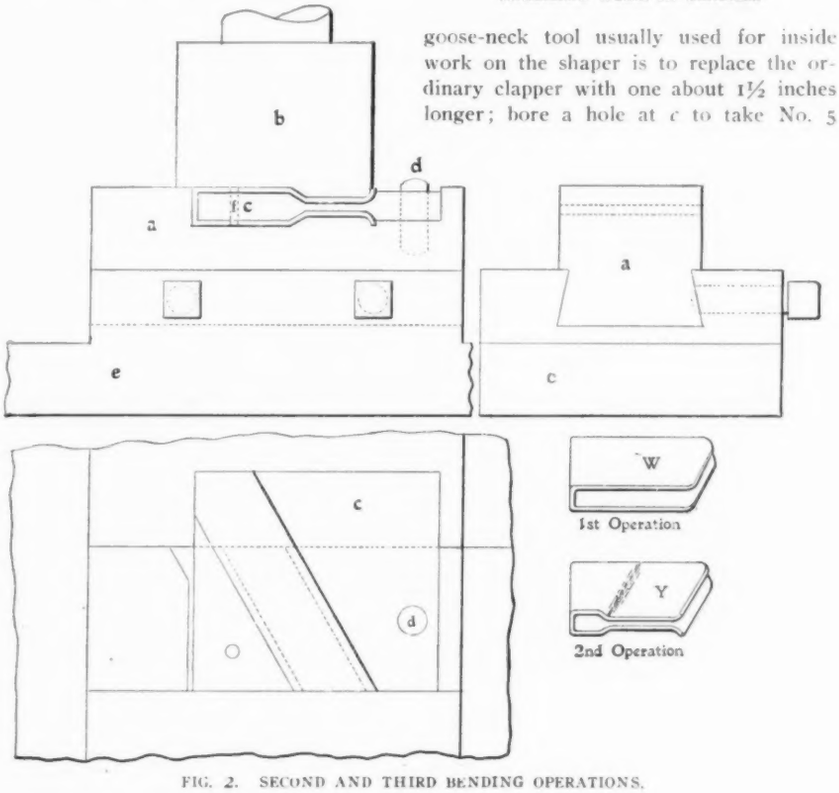


FIG. 2. SECOND AND THIRD BENDING OPERATIONS.

Keying Hubs on Shafts.

Editor American Machinist:

In answer to Mr. Mather's inquiry at page 827, I would say that the unmechanical features of the construction shown are so obvious as to need no comment. One point is that the angular contact between shaft, key and hub would tend to have a wedging or bursting effect on the hub.

KEYING HUBS ON SHAFTS.

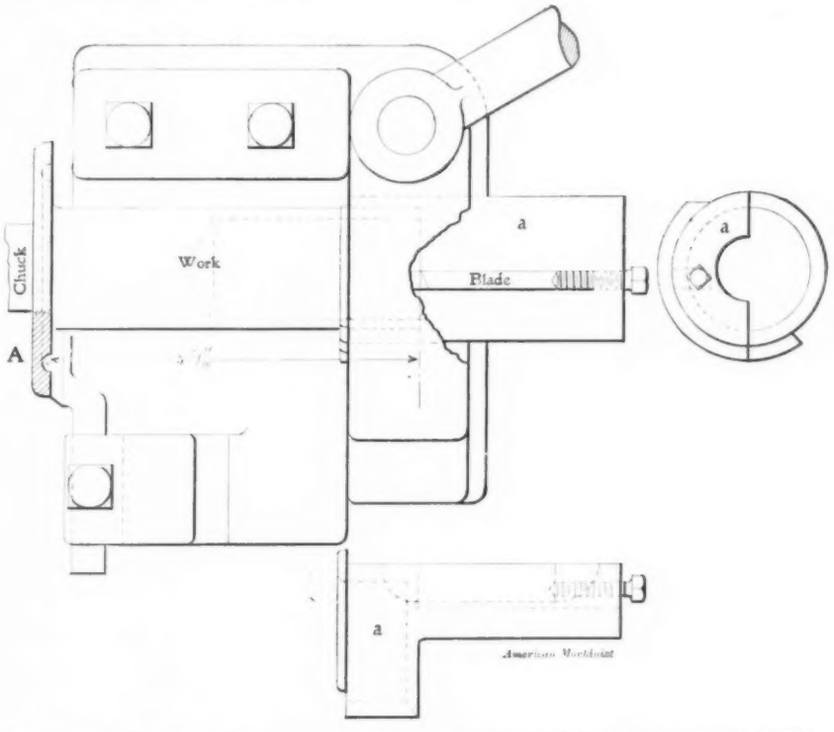
Some years ago the Syracuse bicycle used a crank connection like the sketch, which, if I remember right, was anything but a success, as the crank *would* work loose, the key rocking in its seats.

GEO. WILSON.

Finishing Work to Length With a Tool Mounted on Carriage of Turret Lathe.

Editor American Machinist:

I show herewith a device I have found useful when all the stations of the turret were filled. The object is to automatically turn the work to correct length, in this case 5 7-16 inches. The end of the work was only a shell, but the part to be operated on was inside the steady-rest bushing.



FINISHING WORK TO LENGTH WITH A TOOL MOUNTED ON CARRIAGE OF TURRET LATHE.

I made a bushing extra long, milled a slot for flat cutter, put in a set-screw at the back of cutter for adjustment. I then cut away the under side of the bushing to let the chips get away, cut away part of the flange to clear the cross-slide, and the job was done.

The blade being once adjusted requires no further attention. I just fed in till I got a clean cut for the spring seat at *A*, when I knew the work was finished to length.

ISAAC MORGAN.

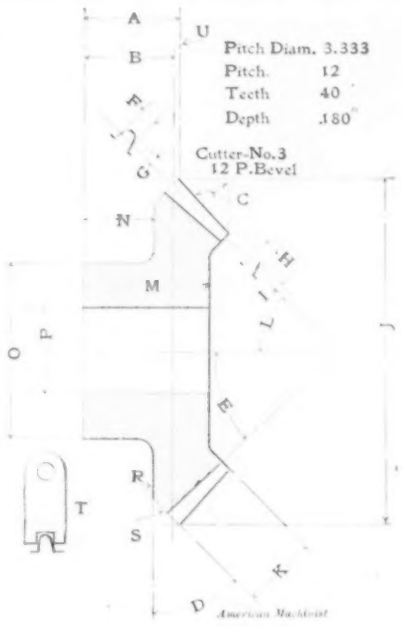
Dimensioning Bevel Gears for the Machinist.

Editor American Machinist:

I fully agree with Robert A. Bruce when he says, at page 549, "It is quite common to find unnecessary or insufficient dimensions on the drawings of bevel gears." I have met few draftsmen who have known what dimensions are needed for turning a bevel gear and cutting the teeth. The best way to find out what is wanted is to go into the shop and do the work. If the draftsman has no such opportunity, then let him watch the workman cut a gear, and observe how much time he wastes in milling the teeth by the cut-and-try plan when the proper dimensions are lacking. It appears to me that the drawing illustrating Mr. Bruce's article might have had one or two more dimensions, especially if the teeth were to be cut on the ordinary milling machine.

Referring to the sketch herewith (which sketch, with the addition of one or two notations, shows a drawing made by a student at the Michigan Agricultural College) it is suggested that dimension *A* would be useful to the machinist. Having this distance, the machinist can finish the hub of the gear independently of the pitch circle; otherwise the back edge *S* should be machined and the pitch circle (or a point in the same) marked in order to get the hub distance *B*. To finish the end of the hub without regard to the pitch cone would be to take chances on this important part (*U*) of the gear "truing up." In many cases the end of the hub abuts against a fixed bearing. If too short, the gear is thrown just so much out of mesh with its mate.

Let us consider how the machinist would proceed to turn the bevel gear after placing



DIMENSIONING BEVEL GEARS.

it upon an arbor or mandrel. Assuming the blank to be of such shape as not to require the preliminary roughing-out process, the outside diameter *J* might be turned to size at once, thus providing a cylindrical surface on which to establish the line *U* of the outside diameter. With this line established the hub length may be marked off, or turned at both ends by direct measurement. The back surface *R* also may now be machined. The remaining lathe work will be simple.

In cutting the gear in the miller the pitch circle is not essential. Having the dimensions *F*, *G*, *H*, *I* and the total depth, the workman can set for full depth by the graduated dial of the miller, and gage the thickness for both ends of the teeth by a gear-tooth vernier, or by a gage as at *T*. Or, if preferred, he may mark with morphidite calipers from the outside diameter points on the pitch circle for one or two teeth, and describe arcs showing the thickness of those teeth. This may facilitate the work on a gear of which the settings have not been previously recorded.

There are so many dimensions on the sketch accompanying this article that it may be proper to state the purpose of such dimensions as have not already been noticed. *C*, *D*, *K*, *M*, *N*, *O* and *P* are needed in machining the blank, and *E* is the cutting angle required in setting the spiral head. It is possible of course to get along without some of these dimensions, but from an experience of years in making

such drawings I am convinced that the utility of the dimensions justifies the time required in giving them.

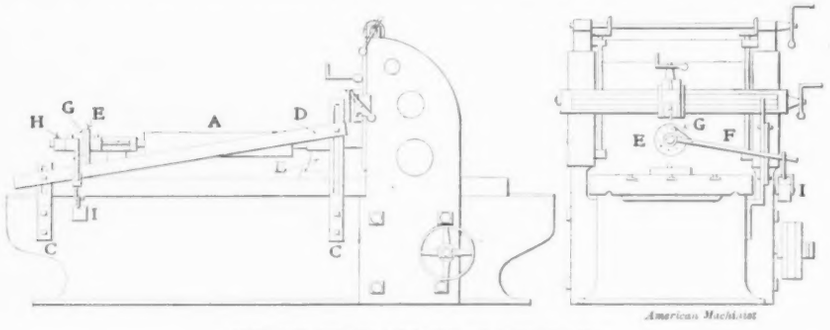
W. S. LEONARD.

Agricultural College, Mich.

Cutting Spiral Grooves on the Planer.

Editor American Machinist:

Mr. Coombs' article, at page 544, on circular work done on the planer, brought to mind the way we rigged up at very little cost to do a job of spiral grooving on the planer in the days when we had no spiral



CUTTING SPIRAL GROOVES ON THE PLANER.

milling machine. The accompanying sketches with a little explanation will show how it was done. The piece to be grooved was 5 feet long and had a bearing on each end 12 inches long by 1½ inches diameter. The part to be grooved was 5 inches in diameter. There were to be ten grooves 3-16 inch wide by ¼ deep and to have one-eighth of a turn in their length. Referring to the sketch, *A* is the work held by its bearings and free to turn in the stands *B* which are bolted to the bed. The uprights *C* and the inclined piece *D* were made from bar stock picked up around the shop, slotted and the uprights bent to shape and bolted to the side of the planer. The piece *D* was then bolted to the uprights and being adjustable in the slots any angle of spiral within its limit could be obtained. The index wheel *E* was made from gray iron and had ten taper holes equally spaced. The wheel was made a fit on the end of the bearing which projected from the box and was fastened to the bearing close to the box and with a collar on the other side of the box fastened to the bearing prevented any end movement of the work. *F* is the lever fitting the bearing and fastened to it which, sliding on the inclined piece *D*, turns the work. *G* is a stiff spring bolted to the side of the lever and having a short taper pin in the end fitting the holes in the index wheel. The collar *H* fastened to the bearing prevented the lever from moving endways. *I* is a weight to keep the lever on the incline while running back over the work. The operation was like this: With the spring pin in a hole in the index and the lever tightened on to the work as the work advanced toward the tool the lever rising on the incline turned the work and produced the required spiral.

PAUL WESLEY.

[Of course our contributor satisfied himself that this was all right for the job in hand, but, owing to the fact that the inclined surface is straight and therefore at varying distances from the work throughout its length, the groove produced is not a true or uniform spiral but only an approximate one.—Ed.]

A Milling Fixture.

Editor American Machinist:

The illustrations show a milling fixture for holding a piece that requires a number of slots in it. The piece is shown at Fig. 1, and as the slots were all required to be of an equal depth and were cut with a gang of saws, it took a very strong jig to hold it. This jig produced a first-class job. The jig is shown at Fig. 2 on the machine in position. It is composed of a flat plate 14 inches long with a feather in the bottom to locate it square on the table. The feather is not shown in the cut, but is the same width as the slot in table. There is also a slot cut along the top to locate the head and the angle-plate at each end of the plate. The main part of the jig is the holder shown at Fig. 3; it has a taper shank that fits the head, the other end is turned parallel to fit a hole bored in the angle-plate. The head and angle-plate come up high enough to allow the piece to revolve. The turned part is drilled out for a ½-inch screw which tightens up the sliding block *A*. The piece is placed in the jig as follows: The flat end is put in at *B*, which has a thin steel plate on both sides of it to hold the work central. The holder across *c*, Fig. 3, is just the same width as the work, so the plates are screwed on and never removed. The plates are shown on Fig. 2. The sliding block *A* is then screwed up tight and, having a radius the same as the end of the piece, holds it very firmly. The holder is strengthened at *D*, so that the screw cannot spring it. It is also cut away deep enough across *E* for the saws to pass over.

C. ALIPER.

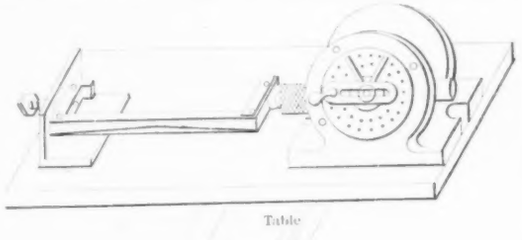


FIG. 2

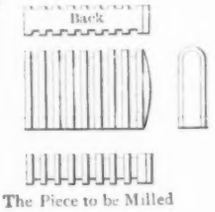


FIG. 1

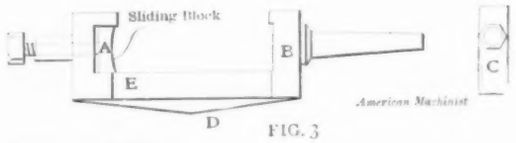


FIG. 3

A MILLING FIXTURE.

Use Soda Water on the Emery Grinder.

Editor American Machinist:

Of course no up-to-date shop has its water tool grinder tucked away in a dark corner, as has been too frequently done in the past, nor is the emery wheel allowed to become lopsided and hollowed out in the middle before it is trued up; but how about keeping the machine clean and free from rust? I have seldom seen one as well kept as it should be. The material removed by the wheel sticks together, rusts, and forms a solid mass that has to be scraped off, requiring considerable time for its complete removal, and all parts of the machine exposed to the action of water become thickly coated with rust. We are all familiar with the use of soda water on the universal grinder, but I have never seen it in use on the water tool grinder except in the instance where I have used it myself. It has given such good results that it occurred to me that others might like to try it. By using a little sal soda in the water the tools and machine are prevented from rusting and the material removed from the tools remains bright and looks much like the sawdust made by the power hacksaw. The machine remains clean much longer than it does when soda is not used, and when cleaning becomes necessary it is more easily done. The cost is next to nothing and as the soda prevents bacteria from living in the water, the disagreeable odor so commonly noticed about these machines is conspicuous by its absence.

WILBERT S. DREW.

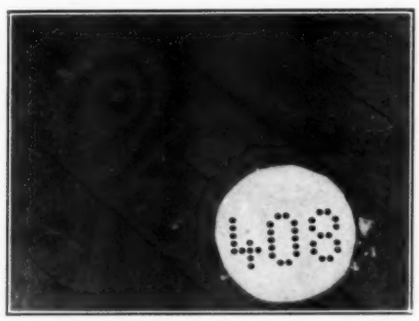
Macatawa, Mich.

Marking Negatives.

Editor American Machinist:

Referring to the letter at page 800, asking for suggestions on marking negatives for filing, etc., I wish to describe the method I use for the Browning Engineering Company.

I use round paper disks, ¾ inch in diameter, and on these I punch the numbers with a check perforating punch. The film is scratched off the negative for a



MARKING NEGATIVES.

space of about ⅜x⅝ inch, and the number, being previously soaked in water, is pressed on in position, sufficient moisture being in the paper to soften the gelatine on the negative and cause the number to adhere firmly to the plate when dry. A blueprint of each negative is then kept in a scrap book divided off under different heads, such as electric cranes, locomotive cranes, motors, etc., and subdivided into different parts of the various machines, making it very easy for anyone to pick out the photograph required to show exactly what is wanted in each particular case much more readily than could be done by reading over a description which could not be detailed sufficiently to cover everything shown on the photograph. The negatives are kept in a case ten to a division, the divisions being marked 10, 20, etc., up. The corner of the photograph shows the mode of numbering.

RALPH R. ROOT.

Claims a Patent on the "Experimental Joint."

Editor American Machinist:

At page 863 I notice a description of an "Experimental Joint" which your correspondent evidently describes as something original. You will find, by referring to United States patent No. 660,862, October 30, 1900, that the salient features of this joint have been patented by me.

I am pleased to hear such corroboration of the utility of the joint under such a severe test, but must also call your attention to the fact that its manufacture and use is an infringement of my rights in the above-mentioned patent.

LUTHER D. LOVEKIN.

Camden, N. J.

An Improved Lathe Tool-Post.

Editor American Machinist:

Figs. 1 and 2 show an improved form of tool-post which on account of its handiness well deserves to supersede the one of circular form. By its adoption the use of bent tools for working close to the face-plate is almost entirely obviated. As regards cost, if the methods of manufacture to be detailed are followed, this should not exceed that of the circular post.

The tool-post body is a steel casting. The central hole is drilled and the bottom face and top boss are turned, the casting being driven on to an arbor for this purpose. The recess *A* in the bottom, which is to insure that the post will bear on the slide-rest in such a way that it has no tendency to rock or pivot on the center, is cast in. The surface upon which the rocking tool adjusting block *B* rests is turned, two castings being *turned* at a time bolted on angle-plates fixed on a lathe face-plate. The rocking pieces themselves are formed from a welded iron or mild steel ring, as shown at Fig. 3, turned to the correct section, but rather larger in diameter than their bedding place on the post, was turned, to cause them to bear rather heavily on the parts *C C* to avoid rocking on the center, and sawn up as shown by the black lines by means of a circular slitting saw. The center of the length is turned away to insure that the tools have a two-point bearing.

The checkering is milled by means of a gang of cutters. With care and the use of a thick saw to avoid spring, after these processes the rings are quite finished, if we except the removal of the little burr that will be left after sawing, and hardening.

This method of manufacturing rocking

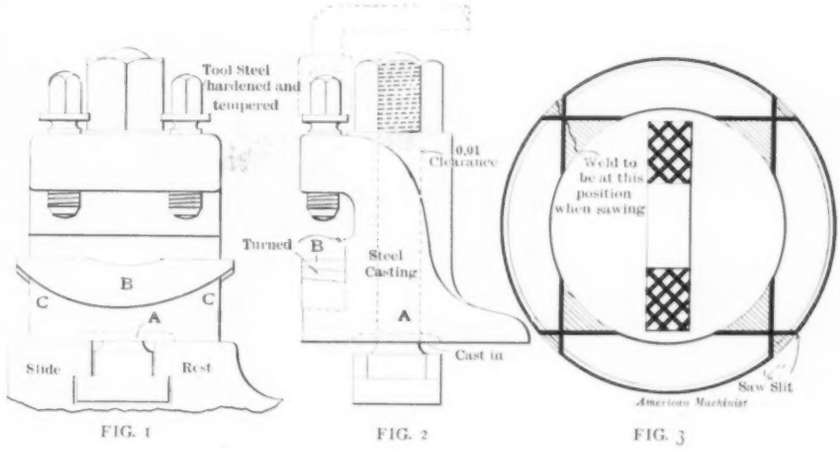


FIG. 1 FIG. 2 FIG. 3

AN IMPROVED LATHE TOOL-POST.

pieces saves money over that of buying drop forgings and finishing them in the ordinary way. TOOL POST.

Wants Ready-made Drill Jig Bushings.

Editor American Machinist:

I wish some of the twist drill makers would make a full line of tempered steel bushings for drill jigs with outside diameters varying by eighths or quarters. It seems to me that this would be as great a convenience as ready-made punches and dies which the makers claim can be made so much cheaper in large quantities than by the small factories for their own use.

NEWELL SANDERS.

The Consumer's Influence in the Improvement of Products.*

The influence of the consumer on commercial products is far greater than is commonly supposed. We are so accustomed to regard the great mass of commercial products as so completely in the hands of the producer, as a something that the consumer is quite at liberty to take up or let alone as suits him, and as something in whose preparation he, the consumer, has had no voice, that the idea that the consumer does actually have an influence on, or exert some force in, giving shape and form, or in deciding on the qualities which the article shall possess, does not seem evident at first sight. And yet we do not hesitate to affirm that the influence of the consumer appears in every successful commercial product, however great or however small, and that the consumer's power over the product, although perchance not appearing in formal and carefully prepared specifications, is nevertheless often fully as great or even greater than that of the producer.

In staple articles of almost universal use the silent influence of the consumer on the product is granted. He would be a short-sighted producer who would attempt to ignore the demands expressed or understood, nay, even the foibles of the consumer, or, what amounts to the same thing, would not study his market. But there are cases, such as the making of a new product for which a demand has yet to be created, where the influence of the producer on the product covers the whole field. The consumer does not yet understand the new product, does not yet know what kind of a material it should be, and hence can have no voice in its

*From the presidential address of C. B. Dudley at the Atlantic City meeting of the American Society for Testing Materials.

production. Take for an illustration the new high-speed tool steel. The manufacturer seemingly decides everything in regard to this new product independent of the consumer. He first learns how to make the steel, decides what its composition should be, learns how to treat it, practically changes all our ideas as to what heat will do to a piece of steel, and develops a new art of hardening and tempering, and, after his studies are finished, comes forth with his creation and teaches the consumer how to use it. Surely it may be urged, in such a case as this, that the influence of the consumer on the product is not apparent. But those who so argue we fear can have had very little experience at the birth and death of new things, many of them good new things, which might have had perchance a long life of usefulness if their sponsors had not attempted to ignore the legitimate influence which the consumer has on even new commercial products, the fruit apparently of the brain energy of the producer alone.

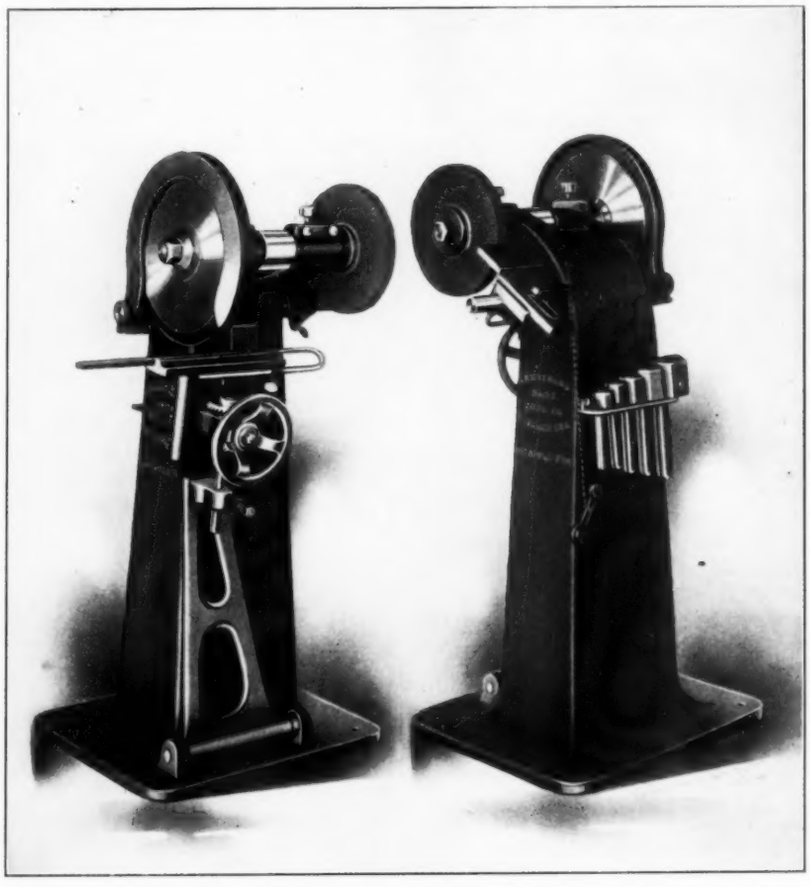
The influence of the consumer on a new commercial product is usually made manifest in the price he is willing to pay for it. If the new product is higher in price in proportion to results obtained than that which he is at present using, or if, even though economies are shown, he conceives that the price is unreasonable, he will usually go on as he has been doing in the past, with the result that the new product fails to be successful. Makers of new things far too often make one or both of two serious mistakes: They either fail to sufficiently study the present condition of the field which their new product proposes to occupy, and as a consequence make the product cost so much to manufacture that it cannot successfully compete with what is already in the field, or, having studied the field carefully and thoroughly, and having developed a new product which is a decided step forward over present practise, and which produces notable economies, they place a price on their product such that the ultimate economy to the consumer is so small that there is no real reason why he should change. Not once, but scores of times, have we seen new commercial products fail from one of these two causes. The man who fails to study his field and makes his product cost too much should have our pity for his short-sightedness. The man who, having devised and worked out something new which may be actually useful and valuable, and who claims for himself *all* the financial advantage of the step forward, will find that he is killing the goose that may lay golden eggs for him, and that the disappointment which will inevitably follow his action is no more than a just punishment for his attempt to ignore the right of the consumer to a share in the advantage which comes from the progress of knowledge.

Cutting Self-Hardening Steel.

We have received the following inquiry from one of our readers:

"Some time since I noticed the cutters that came with some Armstrong tool-holders showed a cut about 1-16 inch deep on the four sides, the steel was ½ inch square, and had broken irregularly, showing that the cut was about 1-32 inch wide; it looked as if ground and the bottom of cut showed curvature. How was it done?"

We referred his query to the Armstrong Bros. Tool Company, Chicago, to whom we are indebted for the photographs of the machine. Fig. 1 shows the grinder which has mounted at one end of the spindle a steel disk into the perifery of which particles of self-hardening steel have been forced. This coating of self-hardening steel does the actual cutting. A bar of self-hardening steel will be seen lying in the swinging rest immediately under the the cutting disk. The disk is not supposed to cut clean thru the piece of steel, but to nick it on all four sides, say, 1-16 to ⅛ inch deep; it is then broken off by a hammer blow, the steel being placed on a small concave anvil which is a part of the equipment that goes with this machine. The small, round, bent bar is the length gage. The hand-wheel connecting with the screw gives the desired depth of cut. After the right depth has been obtained the steel is turned over and the rest is rocked backward and forward for each succeeding cut. Fig. 2 shows the other end of the spindle on which is mounted an emery wheel, with an adjustable rest. In a rack will be seen five gray-iron tool-holders. These tool-holders are for grinding the tools to correct shape. The holders are inexpensive and entirely do away with the destruction of the regular tool-holders which ordinarily results from the men using them to hold the cutters while grinding.



CUTTING SELF-HARDENING STEEL.

The Boston *Herald* of June 19 contains an article setting forth a scheme to transfer the machinery exhibit now at St. Louis to Vienna to form part of an exhibition which is to be held there. Judah H. Sears, of Boston, seems to have charge of this enterprise, and it is stated that the Austrian Government authorities and the Washington authorities have endorsed the enterprise. It would seem to us to be quite important that the endorsement of the owners of the machinery should also be secured and perhaps it will be. It is announced that the Austrian Government will give to exhibitors the free use of the Rotunde, ample power for running all machinery free and that no customs duties will be charged on exhibits. There will be also reduced freight rates.

Prof. Unwin on Testing Materials.

There has recently been published by the Institution of Civil Engineers an excerpt from its proceedings, which excerpt is devoted to the presentation of a paper by Prof. W. C. Unwin, entitled "Tensile Tests of Mild Steel and the Relation of Elongation to the Size of the Test Bar." The paper is, we think, important and is likely to have an important influence upon the methods of testing as generally practised in Great Britain, as indeed it ought to have here. Professor Unwin's paper is much too long for reproduction entire, but we quote passages from it as follows:

For the determination of the quality of steel recourse is had to: (1) chemical analysis; (2) mechanical tests, in which the material is subjected to straining action and definite measurements are made; (3) workshop tests, such as cold and temper bend tests; and (4) for certain purposes, microscopical examination of structure. Chemical analysis is of great value to the steel manufacturer, but the engineer is not directly concerned with the composition of steel, but only with its mechanical properties. It is only so far as the influence of different constituents, or percentages of constituents, has been ascertained by correlated mechanical tests, that chemical analysis is of value to the engineer. Hence, mechanical tests are fundamentally the most important, and if they could be made stringent enough it would be undesirable that the steelmaker should be hampered by specifications of chemical composition. Unfortunately, mechanical tests, as hitherto made, are not wholly satisfactory, and hence they are generally supplemented by restrictions as to chemical composition and by rough but useful workshop tests. This really makes the specification of steel cumbrous and complicated, and it certainly happens that inconsistent requirements are often specified. As to chemical analysis, it should further be pointed out that it is becoming clear that the mechanical properties of steel depend quite as much on its structure as on its composition.

Ordinary commercial tests are necessarily carried out on a rigid routine system, in which speed and reduction of cost are dominant conditions. Their object is merely to detect obviously inferior material. It is not the aim of this paper to suggest a modification of ordinary commercial tests, but only to point out some respects in which their results may be misleading. Experience shows that, under present arrangements, engineers do obtain fairly satisfactory material, tho there are cases where the tests appear to fail in indicating inferiority of quality which appears afterward in the use of the steel.

If ever the present cumbrous system of chemical, mechanical and workshop tests is to be simplified, it would seem that the mechanical tests must be made more stringent and exact. It is just possible that if tensile tests were so carried out that the results were strictly comparable, and stricter limits of quality were insisted on, the additional tests now required might be dispensed with.

In connection with the work of the Engineering Standards Committee on ship material, the author carried out tests on various qualities of steel; and he took the opportunity of arranging the scheme of tests specially to throw light on the conditions which affect the measurement of elongation. It is one object of this paper to show how elongations can be measured either on bars of the same size or on bars of different sizes, so that they are comparable and have a definite meaning.

By ductility is meant the property of plastic yielding, a property which, much increased at high temperatures, permits steel to be molded by rolling or hammering. The converse of ductility is rigidity or hardness. In tensile tests the ductility is measured by the amount of permanent or plastic elongation reckoned per unit length. For the product of strength and elongation, reckoned per cubic unit, a quantity which in similar materials is proportional to the work of deformation, the term toughness is used, and the converse of this is brittleness.

The importance of ductility is due to this, that in the operations of the workshop, and from defects of accuracy of workmanship in compound structures (riveted structures, for instance), the limit of elasticity is often exceeded locally. A ductile material will yield in such cases, and the variation of stress will be much less than it would be in a material incapable of plastic deformation. Recently, notched-bar tests, either by statical loads or by impact, have sometimes been described as tests of ductility. It appears to be overlooked that by notching a bar, its ductility in the ordinary sense is destroyed. Such a bar breaks by a progressive tear, starting from the nick, and there is no measurable deformation in the plane of fracture. Tests of this kind probably have a considerable technical value, but the interpretation of them requires further study.

With the weaker metals the results of testing differ considerably, according as the rate of loading is fast or slow. In the case of steel the time effect is negligibly small, as respects both breaking stress and elongation, for such variation of rate as is likely to occur in ordinary testing. But this is only true provided no inertia forces due to the testing machine itself come into play. With all forms of testing machine, and especially with some forms used in this country, inertia forces of considerable magnitude may be introduced, if there are considerable variations in the rate of straining. The use of accumulators permits excessively rapid straining in the final stages of a test. In the German State Laboratories the rate of elongation during test is limited to 2 per cent. per minute; but in this country the rate is often 25 per cent. per minute. Inertia effects will, other things being equal, be 136 times as great in the latter case as in the former. Some apparently inexplicable anomalies in ordinary testing are, in the author's opinion, due to unreckoned inertia forces at the end of a test carried out more rapidly than is desirable.

When, in the reduced part of the bar, the stress passes the yield stress, and the deformation is considerable, the stress on the enlarged ends is still below the elastic limit, and they are very slightly deformed. Hence, the deformation in the reduced part near the ends is hindered. This effect extends for some distance from the enlarged ends. In ordinary test bars, especially short bars, the effect almost certainly extends to the part between the gage points and so affects the percentage of elongation.

COMPONENTS OF THE ULTIMATE ELONGATION.

The total elongation of a bar in a gage length l is made up of two parts, one due to a general elongation, approximately uniform along the bar, and therefore proportional to l, the other due to a local stretch and contraction of section which occurs in the last stage of testing, after the maximum load has been reached. This local stretch depends on the sectional area of the bar, but not at all on the length between gage points. Hence, at least very approximately the total elongation e for bars of the same material and cross-section is

$$e = a + b\,l \qquad (1)$$

where a and b are constants. The first term on the right is the local, and the second term the general elongation. The equation is applicable if l is not less than the length affected by local stretching, or so great that the elongation is sensibly affected by the enlarged ends. This equation has been given before,* and has been verified in many cases. The percentage of elongation is

$$e\% = 100\,\frac{e}{l} = 100\left(\frac{a}{l} + b\right)$$

or, if the numerical constant is included in the other constants,

$$e\% = \frac{a}{l} + b \qquad (2)$$

It is clear that the percentage of elongation for a bar of a given size diminishes as the gage length is greater. This is well known; and it is common to specify the gage length in which the elongation is measured. It is not generally recognized that the part of the elongation due to local contraction depends on the section of the test bar, and that therefore the percentage of elongation in a given gage length increases as the section of the bar is greater.

To obtain strictly comparable elongations, the gage length and cross-section must have a definite relation and must be specified. The difficulty of comparing the elongations of different test bars would probably disappear if the general elonga-

* Unwin, "Testing of Materials," p. 70.

tion, or elongation at the moment of maximum load, were taken as the measure of ductility, and this has sometimes been proposed. But there is no way hitherto known for obtaining the general elongation except by taking an autographic load-strain diagram.

The general law that similar test bars deform similarly was first stated by Mr. J. Barba. It follows that, for cylindrical test bars the percentage of elongation is constant for a given material, if the ratio of gage length to diameter is constant. In plate test bars not strictly geometrically similar the percentage of elongation is practically constant, if the ratio of gage length to square root of cross-section is constant. The form of cross-section within somewhat wide limits, if the area is constant, does not appear to influence the elongation.

In Germany, where most of the testing is done in State laboratories, the importance of Barba's law has been better recognized than elsewhere. A normal form of test bar has been generally adopted, for both cylindrical and plate test bars, with a gage length of 20 centimeters (8 inches) and a section of 3.14 square centimeters (0.487 square inch). Such bars satisfy the relation,

$$l = 11.3\sqrt{A} \qquad (3)$$

where l is the gage length and A the area of section. If bars of a different section must be used, the gage length is modified so that (3) is still satisfied. Such bars are termed proportional bars, and may be regarded as virtually similar bars.

The law of variation of elongation with gage length in geometrically dissimilar bars is given in equation (2); it remains to find the variation when the cross-section varies. But the percentage of general elongation is independent of the size of test bar, and only the variation of local elongation requires to be examined—that is, the term a in equation (1). Now, if the parts of two bars of similar cross-section affected by local contraction are similar after fracture, the local contraction must be proportional to the linear dimensions of the cross-sections. Or, since the exact form of the cross-section does not appear to much affect the elongation,

$$a = c\sqrt{A}$$

Putting this in equation (1) and proceeding as above, the percentage of elongation is given by the equation

$$e\% = \frac{c\sqrt{A}}{l} + b \qquad (4)$$

where c and b are constants for a given material. The first term on the right is the percentage of local, and the second term the percentage of general, elongation. The equation applies if the gage points are not very close to the enlarged ends, and if l is not so short that the gage points fall within the local contraction. So far as the author has examined, l must not be less than from $2\sqrt{A}$ to $3\sqrt{A}$. No doubt this length depends somewhat on the quality of the material.

The constants c and b (equation 4) can be found for each bar, and the percentage of elongation for any standard form of test bar, for instance, for the German normal bar, in which $l = 11.3\sqrt{A}$, can be calculated. If this method were followed, percentages of elongation would be strictly comparable. Strictly, the elongations must be computed for fracture at the middle of the gage length, so that the plan of initially marking out half-inch lengths along the bar should be followed.

The elongations measured for similar bars, or for a constant gage length and constant section, tell a clear story, and the following conclusions may be drawn:

(a) The relative ductility as measured by elongation is practically the same, whether the bars are 1 square inch or ½ square inch in cross-sectional area.

(b) The mean percentage of elongation of 1-square-inch bars is greater by 2.6 per cent. than that of ½-square-inch bars.

(c) The ¼-inch plates are generally less ductile than ⅜-inch plates, probably in consequence of rolling at a lower temperature.

(d) There is a marked decrease of ductility with increase of thickness in the case of the ship plates.

(e) There is a small decrease of ductility with increase of thickness in the case of the boiler plates, so that the thicker boiler plates are superior in quality to the thicker ship plates.

SHORT TEST BARS FOR FORGINGS.

If in the case of ordinary tests of plates the results are not strictly comparable, it is much more so in the case of tests of forgings, the size and proportions of the test pieces varying so widely in different specifications. Test bars of 0.25 or 0.5 square inch area, or of ½ inch or ¾ inch or 1 inch diameter, and gage lengths of 2 inches, 2½ inches or 3 inches, are specified in different cases. No relation between the elongation for the same quality of material with these different test bars has been stated, and confusion in the interpretation of the results is nearly inevitable.

It will be seen that the percentages of elongation vary a good deal with varying proportions of test bar. It would be desirable if possible to adopt the rule that for all these short test bars the gage length should be taken so that

$$\frac{l}{d} = 3.54 \qquad \frac{l}{\sqrt{A}} = 4.$$

Then the bar of 0.25 square inch area would have a gage length of 2 inches and the bar of 0.5 square inch area a gage length of 2.83 inches. Probably, however, objection would be raised to this in ordinary commercial testing. But nearly the same result would be reached and the elongations be very approximately the same for a given quality of material, if test bars of 0.25 square inch area had a gage length of 2 inches and those of 0.5 square inch area a gage length of 3 inches.

Mr. J. H. Wicksteed considered that the question raised in the paper was one of vast practical importance, not merely an academic question; and he thought an instance he had in his mind would bring that home. Not long ago a large number of experiments had been undertaken in order to find out whether it was better for a steel plate to have much work or little work put upon it in rolling. With this object, some ingots 15 inches thick had been rolled down to ¼ inch, in order to carry the thing to an extreme, by putting a very large amount of work on the material; while other ingots only 6 inches thick had been rolled down to 1 inch thick. Ordinary tensile tests made on both plates had given 20 per cent. extension only for the ¼-inch plate and 25 per cent. extension for the 1-inch plate. He could not say whether the plates had been annealed; he thought they had been tested as they came from the rolls; but care had been taken that the small plates should not be rolled at too low a temperature, or be unequally cooled by local drafts. The curious feature of the matter was that the results he had mentioned had been taken as indicating, if not proving, that by rolling the plate down from 15 inches to ¼ inch, that was, to one-sixtieth of the original thickness, the plate had been made inferior in ductility to the one which had only been rolled down to one-sixth of the thickness of the ingot. If the author's elongation equation were applied to those plates, it would be found that there was a difference involved in testing a thin plate, if it was of the same length and width as a thick plate—a fact which had never once struck the experimenters who were familiar enough with testing on ordinary lines. As nearly as he could make out, the application of the author's elongation equation to those plates would show them to have had about the same ductility; if anything, the ¼-inch plate would have been more ductile than the other. The faulty deduction from the tests in question had pointed to changes being made in the ingot molds and in the rolling mills, and indeed in the whole policy of manufacture at the works to which he was alluding.

Some of our contemporaries have discovered (*via* England) a number of interesting points about modern American grinding methods as now carried on in machine shops and are advising that anyone who wishes to know how much more accurately a grinder will work than a lathe may turn a shaft in the ordinary way, *smoke it* and then put it in the grinder and note how the wheel marks it—*i. e.*, removes the smoke or soot from the surface. Fancy! A man who cannot tell when an emery wheel has touched a turned shaft without depositing a coating of smoke on the shaft had better not fool away his time with grinders.

Selection of Architects for United Engineering Building

The Conference Committee of the three national engineering societies and of the Engineers' Club, charged with the responsibility of giving effect to the gift of Mr. Andrew Carnegie of $1,500,000 for the erection of two buildings in New York city suitable for their respective purposes, has made the selection of architects for the respective structures. Since the middle of June the committee has received twenty-six complete sets of competitive plans for the two buildings, inclusive, comprising over 500 drawings, and with the assistance of Prof. W. R. Ware, as expert adviser, has spent a good deal of time in the consideration of these designs, all of which, of course, were submitted anonymously. The conclusions now reached are unanimous and are approved by the professional adviser. The successful competitor for the United Engineering Building is Herbert D. Hale, of Boston, with Henry G. Morse, of New York, as associate architect. Mr. Hale is a grandson of Edward Everett Hale, has done a large amount of public architecture in New England and has constructed some Carnegie libraries, besides doing a very considerable amount of work for the New York Shipbuilding Company. The successful competitors for the Engineers' Club are Whitfield & King, of New York, who have done a large amount of work in New York city and on various Carnegie libraries, and were also associated in work on the buildings of the Pan American Exposition. The designs of this firm were also among those favorably considered for the United Engineering Building, awarded to Mr. Hale. The successful competitors in the open class for equal prizes of $400 each, in addition to Mr. Hale, are Trowbridge & Livingston, of New York; Frank C. Roberts & Co., with Edgar V. Seeler, associate, Philadelphia, and Allen & Collins, of Boston. It is interesting to note that a very large proportion of the competitive designs came from Boston and that the largest prize, namely, the award for the United Engineering Building, as well as one of the smaller money prizes, has gone to that city.

A Remarkable Air Compressor.

L. C. Kiser, Decatur, Ill., has invented an air compressor which has been favored with a long "write-up" in a local paper and an appreciative correspondent has kindly sent us a copy. We can only reproduce the following which will be appreciated by those who are at all familiar with the theory and practise of air compression:

"In compressing air to high degree it liquefies and this sometimes occurs in the Kiser machine, much depending upon the atmospheric conditions under which the machine is working. In the cylinder there is a drip thru which the liquefied air may escape before reaching the reservoir. Compressed air is cold, but the high pressure under which it travels heats the pipes, and that is one of the problems that the inventors have had to deal with. Mr. Kiser has patented a device by which the compressed air travels around the pump cylinder on its way to the reservoir, thus keeping the cylinder perfectly cool and in no way detracting from the power of the air."

The London Water Works.

The several companies supplying the city of London with water have been absorbed by the city government. Some of the private companies have afforded the most striking example of the folly of the granting to private corporations a monopoly of supplying to a city a thing which is an absolute necessity and which at the same time is of such a nature or must be supplied in such a way that there cannot possibly be such a thing as free competition in it. The shares of stock in these companies had in some cases risen to fabulous values—values based upon the right of the companies to levy tribute upon the inhabitants of London to an extent utterly undreamed of when the original charters were obtained—charters which, tho granted and obtained by men now long dead, were held to be binding upon people very much alive. Our contemporary, *Engineering News*, thus comments upon the facts of recent occurrence in this connection:

"The most notable example of the private ownership of water works on record ceased to exist on June 23, when the eight water companies supplying metropolitan London transferred their works to the Metropolitan Water Board. The total price to be paid by the new board for the works has not been fully determined, owing to certain appeals by the companies from the decisions of the arbitrators to the House of Lords. The aggregate of the amounts originally claimed by the companies was £50,000,000, or $243,000,000. Some of the claims were cut more than in half, even supposing that the companies win on their appeal. Mr. William B. Bryan, chief engineer of the East London Water Works Company, has been selected by the Metropolitan Water Board as its chief engineer. American engineers will be interested to know that he is to be paid an equivalent of £3,750 a year, or a little more than $18,000 a year, for his services, but he will soon give up the private practise carried on while he was chief engineer of the company. Some idea of the importance of these combined works may be given by stating that nearly all the water supplied to some 5,000,000 people is filtered and all of it is pumped, while the operating expenses from June 24 to Sept. 30, 1904, have been estimated at about $600,000.

"The transfer of these London water companies concludes a long and sometimes bitter agitation for public ownership at London. That great aggregate of population was one of the relatively few large cities or districts where private ownership of the water works still prevailed. Every year the number of privately owned water works is decreasing, but this is by far the most notable change in ownership which has ever taken place."

The International Congresses at the Universal Exposition.

The International Congress of Arts and Sciences will hold its meetings at the St. Louis Exposition, September 19 to 24, inclusive. The following is a brief summary of a great amount of work laid out.

After the opening of the congress on Monday afternoon, September 19, will follow, on Tuesday forenoon, addresses on main divisions of science and its applications, the general theme being the unification of each of the fields treated. These will be followed by two addresses on each of the twenty-four great departments of knowledge. The theme of one address in each case will be the Fundamental Conceptions and Methods, while the other will set forth the progress during the last century. The preceding addresses will be delivered by Americans, making the work of the first two days the contribution of American scholars. On the third day, with the opening of the sections, the international work will begin. About 128 sectional meetings will be held on the remaining days of the congress, at each of which two papers will be read, the theme of one being suggested by the Relations of the special branch treated to other branches; the other by its Present Problems. Three hours will be devoted to each sectional meeting, thus enabling each hearer to attend eight such meetings, if he so desires. The program is so arranged that related subjects will be treated, as far as possible, at different times. The length of the principal addresses being limited to forty-five minutes each, there will remain at least one hour for five or six brief communications in each section. The addresses in each department will be collected and published in a special volume. It is hoped that the living influence of this meeting will be yet more important than the formal addresses, and that the scholars whose names are announced will form only a nucleus for the gathering of thousands who feel in sympathy with the efforts to bring unity into the world of knowledge.

A writer in *Indian Engineering* tells of a case of wasted labor where a cable was to be laid in a *yielding, shifting pulverulence*. In anticipation of the arrival of the steamer with his "boss" and the cable, he started a multitude of men at digging a trench, which should be 2 feet deep and give good protection to the cable. Try all he could, the trench could not be dug. It filled as fast as they dug. Widening was no good, and embanking impracticable. The "boss" solved the difficulty by simply laying the cable on the surface and throwing sand over it. By next morning the cable had itself worked its way 16 inches down from the surface.

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Prof. Unwin on Testing Steel.

Elsewhere in this issue we publish extracts from a paper by Professor Unwin on testing steel. The discussion which took place on this paper showed that it was considered important, as indeed almost anything is bound to be which is put forth by its distinguished author. It is worth noting that Professor Unwin sharply condemns certain practises generally followed here in testing materials and gives his full endorsement to practically all that has been set forth by the advanced Continental testing engineers as being necessary to secure results that can be depended upon. Particularly is this seen in what he has to say about the rate of speed at which tensile test specimens should be pulled and the effect of the inertia of the moving parts of the testing machines in vitiating results when attempting to do the work at too great speed. This vicious practise has been repeatedly condemned here, particularly by one engineer who has made a special study of testing materials, but its importance has been denied or ignored.

It has been said that if there were important pecuniary interests opposed to the law of gravitation, we should have many people denying that law, a voluminous literature attacking it and many people misled and sincerely believing the law to be a humbug and believers in it to be crazy fools. There can be little doubt that important pecuniary interests have had and are now having altogether too much influence upon the determination of the proper methods of testing materials and especially steel. There has been also unfortunately too much of personality in the discussions of these matters here, and, as is well known, our American society of testing engineers withdrew from the international society because the methods advocated here were not approved abroad and are in fact considered to be demonstrably bad. Professor Unwin's strong endorsement of the Continental, or perhaps we should say the German and French, methods and his equally strong condemnation of the methods usually pursued here might well give pause to some of those who have been so cock sure they were right about all these mattesr and who would have others believe, as some of them appear themselves to believe, that they are perfectly unbiased and sincere.

The importance that the matter of testing may assume is shown in connection with the recent failure of the "Iowa's" guns. The forgings for these guns were rejected by a naval inspector stationed at the works where they were made. They were accepted over his head but at a reduced price on account of small defects which it was declared were not important. Sent to the Washington naval gun factory, they were again rejected by the authorities there as being unfit for use and finally were accepted by a specially appointed naval commission, composed of eminent officers it is true, but none of whom could claim any special familiarity with the subject—to put it mildly. The guns have proven their liability to burst and kill people when loaded as they were designed to be loaded, and it seems a clear case of a strong pecuniary interest prevailing against well established physical laws. So far as we know, there is no evidence of gross corruption in connection with the matter, but at least it looks bad, taking the whole story together, and nobody knows how many failures of rails, axles, bridges, etc., have taken place that would not have taken place at all if the material supplied had been proven by rigid and thoroughly scientific tests to be what was contracted for.

The public has a right to expect that engineers will so far as possible protect it from accidents due to failure of parts of important structures. We hope never to see the time when it will be proven that lives have been lost that would not have been lost if well-known and better methods of testing had been enforced by engineers who had had every opportunity to become acquainted with such improved methods but had not employed them. Professor Unwin's paper, to say nothing of much else that is on record, will stand as a terribly severe indictment of such engineers, and prejudices aroused by personal animosities will then be no excuse.

Standards in Manufacturing.

It is declared by those who ought to know all about it that there are few, if any, reasons why direct-current electric generators should be made to-day, except that the makers of them have standardized their manufacture and cannot well get away from them without considerable pecuniary sacrifice.

Other things might be cited to show that along with the advantages of standardized manufacture there are things to be said against it as well. For instance, a German firm of machine builders was recently advised by its representative in a foreign country regarding the demand for a certain machine which would have to be adapted to the local requirements, and the opinion was expressed that American competition need not be feared for ten years at least, because American manufacturers were so thoroughly tied up with their standards as to make it impossible for them to do much in that field within the period named.

While it is, of course, true that standardization has its advantages and in some lines affords practically the only means of making any profit, there can be no doubt that it has restricted, is now restricting and will in the future restrict development which would otherwise take place.

We are, of course, all familiar with the disastrous effects of introducing a new thing to be made in a thoroughly organized shop working to produce a certain standard line of goods. Not only is the cost of the new thing usually greater than

it would be if made in a shop accustomed to new things, but the cost of all the regular product of the shop is increased as well. It is, of course, natural that proprietors of such shops should hesitate to undertake new or special things, but we are convinced that many of them would strengthen their own position if they would organize separate departments for the building of odd things in their line. Operated as separate departments, they can be prevented from interfering in the least with the regular product, and the cost of work done in such a department can be accurately determined.

A manufacturer who in this way undertakes to build odd things more or less related to his regular line has opportunities for experiment and for intimate study of new ideas, and can often thus get hold of things worth adopting as a standard.

Even here, however, the argument is not all on one side; for, as we noted some time ago, one prominent tool-building concern gave up the practise of building special tools, simply because when they charged what it was worth to build them, the charges seemed so high in many cases that the effect was prejudicial to their regular line of business—people concluded they were robbers, not only on the special jobs, but in all other lines as well.

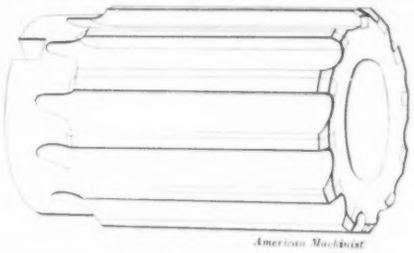
There can be little doubt that standards do occasionally restrict progress by making improvements impossible on account of pecuniary considerations. Where there are a dozen different designs of a given thing, a man with a new idea finds it comparatively easy to introduce the thirteenth design, and a short time after its introduction it may be on the same footing as the rest of them. But where the dozen manufacturers are all making the same thing, which has been adopted as a standard, and every other related thing based upon that standard, progress in design or to meet new conditions is exceedingly difficult, if not impossible. No amount of demonstration that 3 feet or 9 feet would be a better gage for a railroad than the present accidentally chosen 4 feet 8½ inches would lead to the adoption of the new gage. Such things—tho not necessarily the standard by which we measure them—are "irrevocably tied to the past."

Edward W. Parker, of the United States Geological Survey, says that the output of anthracite has reached its limit, and predicts that in little more than half a century anthracite will be a fuel of the past. The stock is now so low and deposited in such inaccessible beds that the cost of production has increased tremendously, and operators are now working seams which only fifteen or twenty years ago were not considered as commercial propositions. The average annual production of anthracite for the past three years was 59,000,000 tons. The output of bituminous coal in the United States in 1902 was 269,000,000 tons.

Some New Things.

HIGH-SPEED STEEL REAMER.

This reamer consists of a body of soft steel with blades of best high-speed steel brazed in. Some results obtained with these tools in the shops of the Sheffield Car Company, of Three Rivers, Mich., are as follows: $1\frac{21}{32}$ inch core drill, rough drilling, hard castings 2 inches thick, ordinary tool of special high grade 5½ carbon steel, drilled 18 to 20 with one grinding, this tool bored 60 to 70 with one grinding (tools used in turret lathe at same speed); $4\frac{3}{8}$-inch reamer finishing brass sleeves 11 inches long in Gisholt lathe, regular tool reamed twenty with one honing, this reamer finished fifty-five under the same conditions; 3½-inch reamer finishing cast cylinders for gasoline engines, holes 11½ inches long, ordinary reamer of special high-grade steel, 5½ carbon, reamed twelve to fifteen with one honing, this reamer finished sixty-five without honing at an increase of one third in speed. Further, it is often desirable to slightly expand a solid reamer either hand or machine. Owing to the soft body, the hole may be drilled into the center from the end, slots cut into the grooves, and a taper pin or screw used



MATTHEWS' HIGH SPEED STEEL REAMER.

to expand the tool, in any of the ways in common use. These reamers are made with extra large and deep centers, to overcome the liability to slip off the center. The centers and squares for hand reamers, the shanks both straight and taper (for reamers used in machines) are case-hardened. Reamers are ground all over after hardening and are made in any style desired. They are manufactured by the Three Rivers Tool Company, Three Rivers, Mich.

"LIGHTNING" HOLDER AND COLLETS.

It is a well-known fact that a great deal of time is wasted while changing tools with the ordinary collets used in the drill press, as the machine has to be stopped before a tool can be inserted or taken out. With these holders and collets this is not the case, as tools can be changed very readily while the machine is in motion.

In placing the collet with its tool in the holder, the operator first lifts the collar *A*; this brings the large part of the recess in the collar *A* opposite the ends of the rolls, which allows the rolls to move further from the center along the elongated holes; he then inserts the collet and, letting go the collar *A*, it drops and the small part of the recess in the collar *A* forces the rollers back to their former position near the center. In this position they grip the collet at the grooves *X* and it is prevented from falling out by the enlarged end of

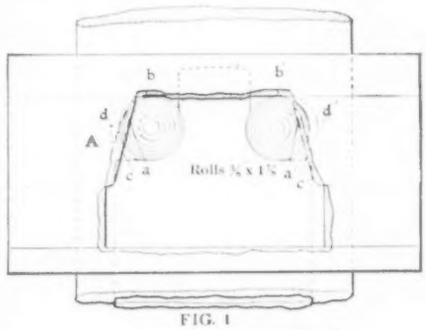


FIG. 1

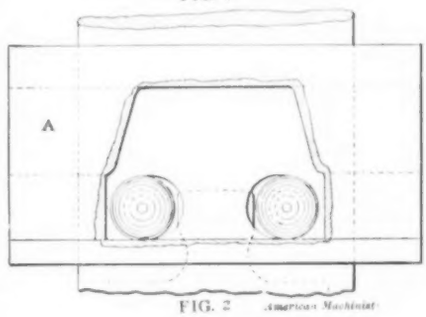


FIG. 2

ACTION OF THE HOLDER.

tang *J*. All parts subject to wear are of steel hardened.

Detailed explanation of Figs. 1 and 2: Fig. 1 shows the collet in place in the holder. The weight of the collar *A* rests upon both ends of both rolls at *a*, *a'*, *b* and *b'*. The weight of the collar *A* by means of the taper sides *c* and *c'* forces the rolls

FIG. 3 Collet

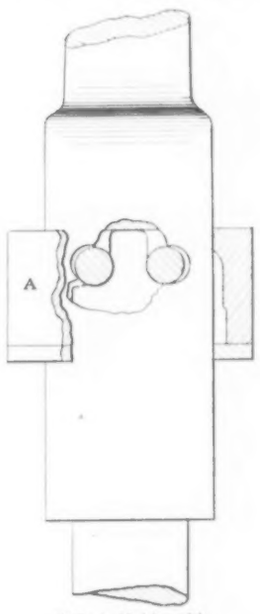


FIG. 4 Holder with Collet in place

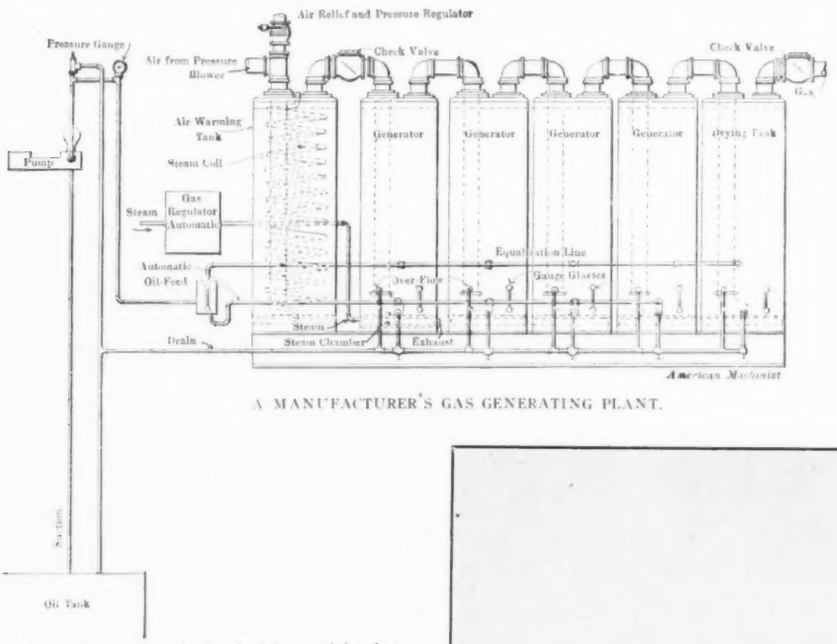
"LIGHTNING" HOLDER AND COLLET.

into the corresponding grooves of the tang of the collet and holds them there until released by some external force. The holes *d* and *d'* are elongated, allowing a play of the rolls, when not held in position by the

collar *A* sufficient to allow the head of the tang to pass in or out.

Fig. 2 represents the collet in the act of passing in or out of the holder, with the rolls to the further side of the elongated holes. The collar *A* is raised as far as the retaining collar on the bottom will permit, which allows the rolls to come into the clearance chamber of the large collar *A*. This admits the side action of the rolls in the elongated holes.

These tools are made by the Mutual Manufacturing Company, Bridgeport, Ct.



A MANUFACTURER'S GAS GENERATING PLANT.

A MANUFACTURER'S GAS GENERATING PLANT.

The use of gas for manufacturing purposes is now so general, and the advantages of it are so great, that the production of the gas to be used is itself an important consideration. The use of natural gas has taught the manufacturers of this country the superiority of gas as fuel in furnaces for forging and heating iron and steel. The supply of natural gas is now giving out, and the location of manufacturing establishments outside of the natural gas producing districts has created strong demand for manufactured gas of similar character to natural gas, and at the same time one which could be generated at sufficiently low cost to make its use practical in furnace work, from an apparatus which could be installed in the individual establishment. City gas is used quite generally for the lighter class of furnace work, such as brazing, japanning, hardening, etc.; but it is very expensive, and many establishments are located out of the reach of the city gas mains.

The cut shows in outline a gas-generating plant as built by The Acme Gas Company, 1010 Monadnock Building, Chicago. This plant generates a gas of similar character to the natural gas, at the low cost of from 10 to 12 cents per 1,000 cubic feet, by forcing air under pressure through a series of generators containing crude distillate of petroleum. The resulting gas is free from sulfur, so that its use in furnaces has no deleterious effect upon the iron and steel heated, as where crude oil is used.

The method of generation is simple and the apparatus compact. The air, which is forced through the tanks or generators containing the crude distillate, is supplied by means of a rotary high-pressure blower or an air compressor. The oil is fed into the generators by means of a pump, and the flow of the oil is proportioned to the quantity of air admitted, so as to make at all times a gas of uniform quality. After the air is admitted into the generators, it is passed, by means of a down pipe, to the bottom of these tanks, where it is set free, and has to force itself up through the crude distillate and through a series of perforated plates, between which is a porous material. These plates and porous

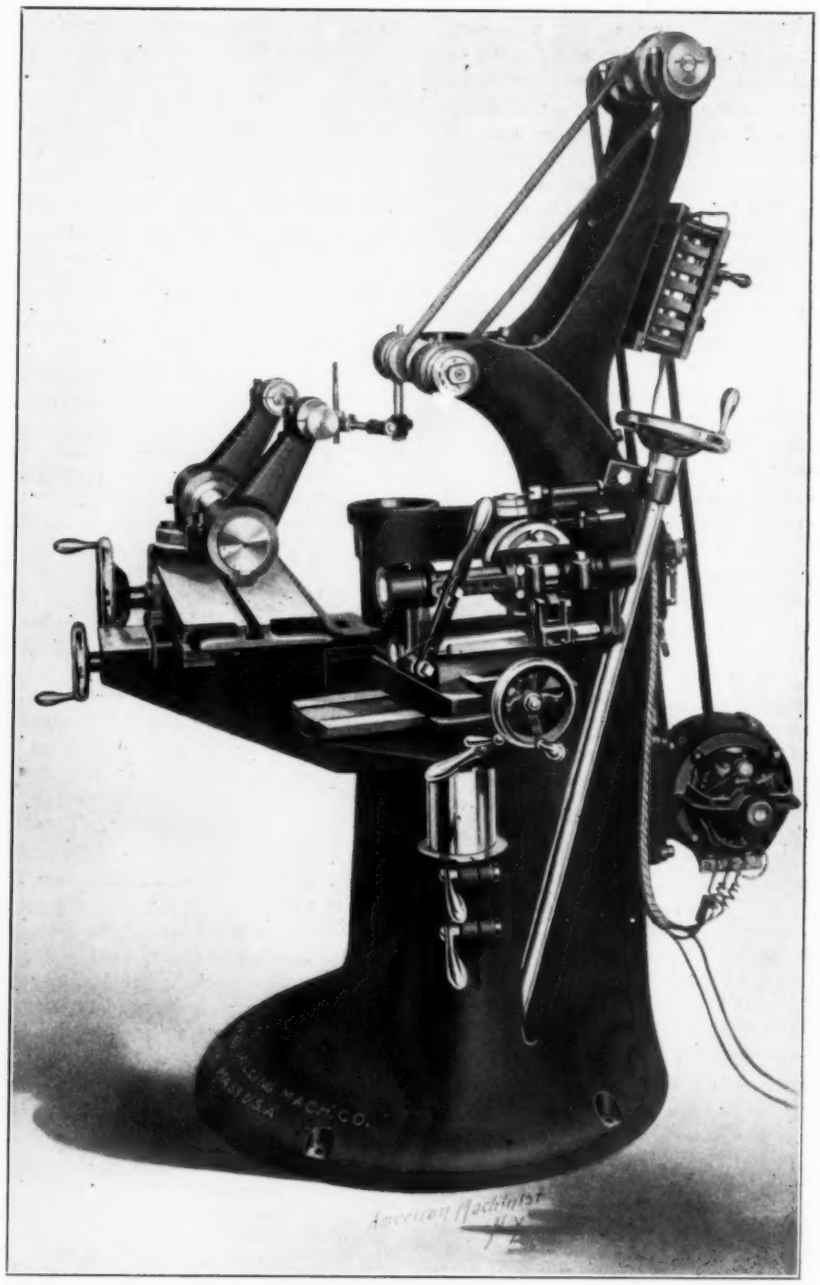


FIG. 1. CUTTER AND REAMER GRINDER, MOTOR DRIVEN.

material serve to break up the air and oil into fine particles, thus bringing the surfaces of air and oil into thorough contact, at which time the air takes up the oil, forming a fixed gas. As it passes through the second generator, the air takes up more oil, and so on, until it passes through four generators, when the process is completed. It then passes through another tank of similar size to the generators, which acts as a dryer, and on leaving the dryer the gas enters the mains and is burned just as city gas or natural gas is used. A parallel pipe of the same size as the gas main and containing air under high pressure is carried throughout the shop, and the air and gas are mixed at the burner before entering the furnace.

The plant is automatic in its action, and produces gas only as fast as it is used, up to the capacity of the apparatus. The gas is claimed to make fully as efficient a fire in a furnace as natural gas, coal or water gas, besides being free from impurities; and it can be used for any purposes to which any other gas can be successfully applied. The low cost of this Acme gas, together with its efficiency, has made it possible to introduce its use most advantageously and with economy in certain types of furnace work to which other gases have never before been applied, namely, for use in open blacksmith forges and for melting brass in crucible furnaces. The plants may be constructed to any capacity required, and there are plants in use at the present time which range in their generating capacity from 1,000 cubic feet per hour up to 150,000 cubic feet per hour.

This gas gives great promise as a source of power for gas engines. Various tests made by gas engine manufacturers indicate that a horse-power can be developed at a cost of about one-third of a cent per horse-power hour. A very superior light is produced by burning this gas in a Welsbach burner.

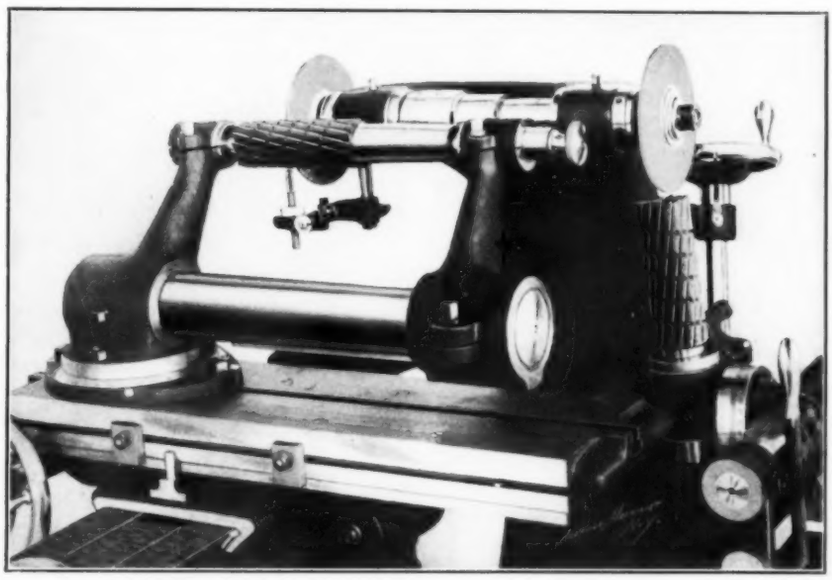


FIG. 2. GRINDING SHANK MILL ON FACE AND END.

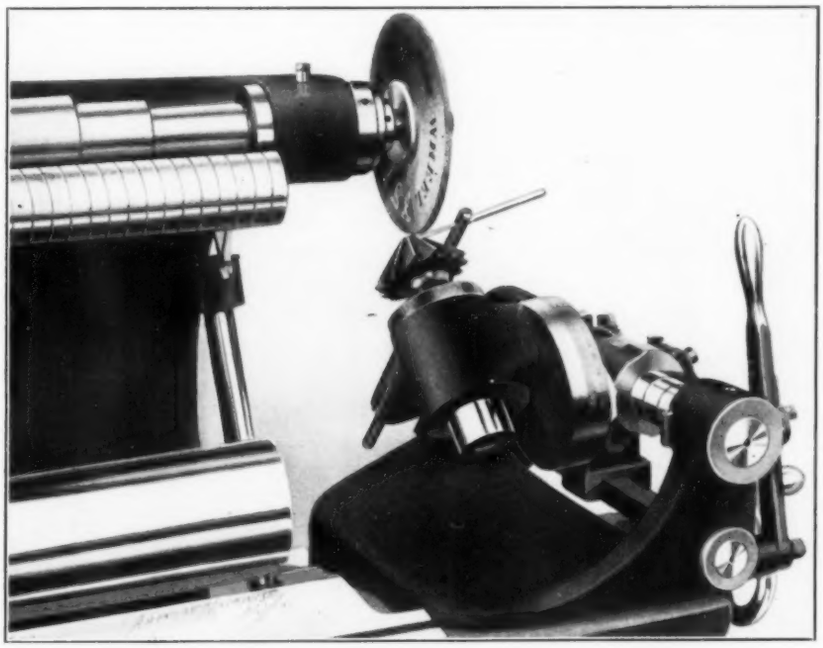


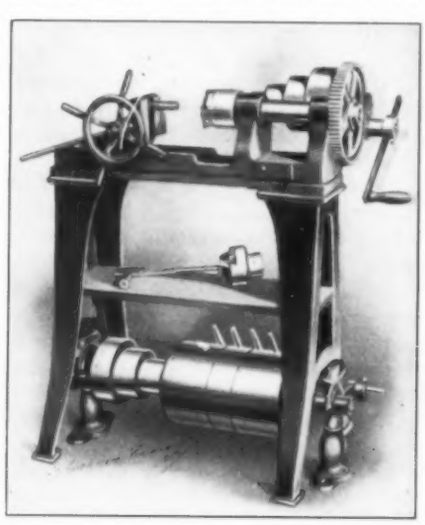
FIG. 3. GRINDING ANGULAR MILL.

A NEW CUTTER AND REAMER GRINDER.

The illustrations show views of a new grinder for cutters and reamers up to 14 inches in diameter by 14 inches long. The machine is practically self-contained—that is, the machine will grind almost all varieties of cutters and reamers without any extra attachments. It is provided with two columns, one of which has a knee, with saddle and table. This table has six inches of vertical adjustment, and will swivel around the column in either direction. The adjustable vertical column is graduated so that setting can be instantly made to give the proper angle of clearance of cutter for different diameters of emery wheels used. The table on the saddle is fed by rack and pinion having a longitudinal traverse of 20 inches and a cross-feed of 7 inches; it is provided with a graduated swivel head which carries a bar on which the cutters slide while being ground. Head and tail centers are also provided for work which has to be ground on centers. This machine is made by the Becker-Brainard Milling Machine Company, Hyde Park, Mass.

BOLT CUTTING AND NUT TAPPING MACHINE.

This machine is designed for threading bolts and tapping nuts up to ¾ inch in diameter. It has a three-step cone for 2½-inch belt running on a shaft parallel to the spindle; to this shaft is splined a small pinion which drives the large gear on the spindle at a ratio of 5 to 1. There is another pinion with adjustable handle to

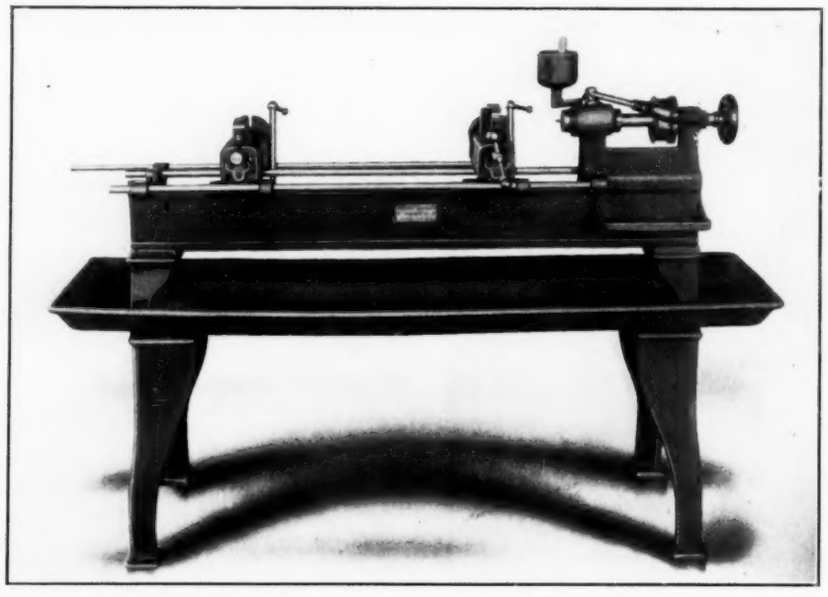


BOLT THREADING AND NUT TAPPING MACHINE.

be used when threading by hand. This gear and handle are removable. All gears are cut from the solid. The spindle is hollow. The faces of the vise-jaws and all parts coming in contact with the taps or dies are of cast steel hardened. It is built by Boynton & Plummer, Worcester, Mass.

CENTERING MACHINE.

The illustrations show a centering machine built by The Hendey Machine Company, Torrington, Conn., equipped with a single spindle of large diameter carrying draw-in attachment with watch tool chuck for accurately gripping center drill and reamer. The front bearing is made taper, after the well-known pattern of the Hendey-Norton lathe head; the spindle is provided with back locking pin for use when removing or replacing the center drill.



HENDEY MACHINE COMPANY'S CENTERING MACHINE.

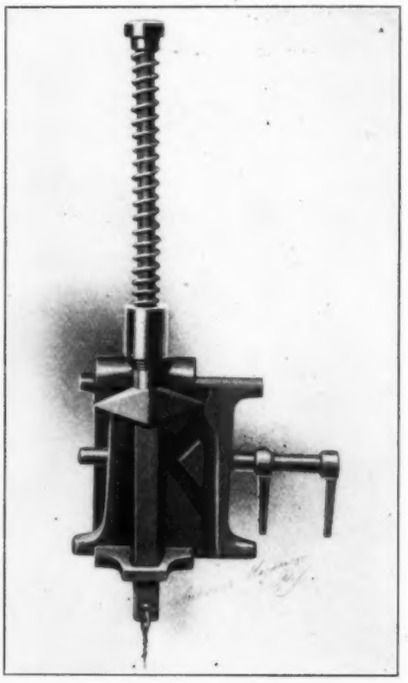
The jaws of the vise and supporting block are made of tool steel, hardened and ground. The block and vise work in unison, the two being kept in proper relation by means of the rod and spiral geared mechanism actuated by a ball handle. The machine has a bed 4 feet 6 inches long, the top surface of which is inclined so that it directs the chips into the pan. The heavy parallel bars running the length of the machine not only protect the bed from abrasion, but act as a temporary support for the stock being centered. The saddles are gibbed and fitted to the bed, and are provided with binding handles for clamping them to position.

The machine is designed to handle stock from 5-16 to 3¼ inches diameter. The first machine was built by The Hendey Machine Company for use in its own shops; after a thorough trial its valuable features were so apparent that the company decided there was a field for this tool outside its own shops, and has built a lot of them.

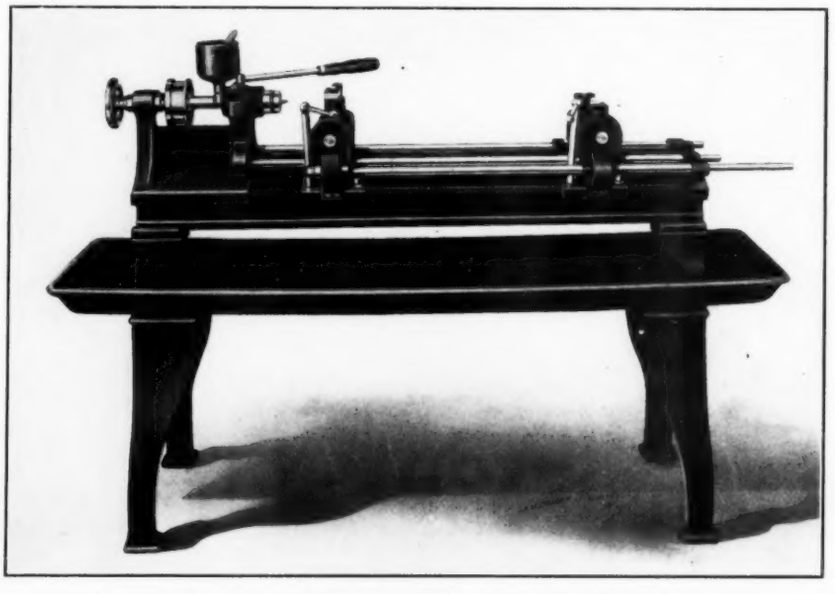
ONE-PULL POSITIVE-LOCK BELT SHIFTER.

Numbers of serious accidents have occurred that might have been prevented had the shifter been thrown over in the right direction at the right time. With this shifter but one pull, always in the same direction, is necessary to either start or stop a machine. It has the further advantage of locking the shifter in position.

The principle upon which it works is similar to that of the crossed right- and left-hand screw which is used on ink distributing rollers in printing presses. In this belt-shifter the diamond-shaped nut (not visible in illustration) is pivoted to a reciprocating bar; the cam plate which carries the shifting bar and shifting fingers reciprocates at right angles to the reciprocating bar carrying the diamond-shaped nut. By pulling the rope the reciprocating bar carries the diamond-shaped nut down through the diagonal slot in cam plate, thus throwing the reciprocating cam plate. When the nut reaches the vertical slot which terminates the bottom of the diagonal slot, it is automatically shifted so as to slide up the vertical slot at the end of the cam plate, being drawn up by the spring on top of the mechanism as soon as the pull is released. At the top of the vertical slots at either end of the cam plate is a small curve which throws the nut into position ready to slide down the other diagonal slot. It will readily be seen that when the nut is in this position the shifter-bar is locked, and that the belt is shifted positively by the hand of the operator, the office of the spring being only to return the nut to the



ONE-PULL POSITIVE-LOCK BELT SHIFTER.



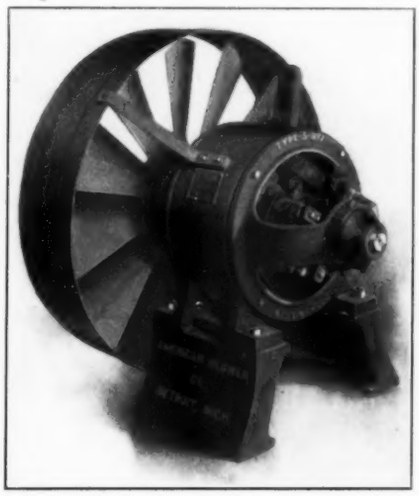
HENDEY MACHINE COMPANY'S CENTERING MACHINE.

locking position and hold it there ready for the next pull.

This shifter is made by the Diamond Clamp & Flask Company, Richmond, Ind.

ELECTRICALLY DRIVEN FAN.

The half-tone shows an electrically driven fan for which there is a wide field of usefulness. Slight modifications have been made in the regular "A B C" fan, and the motor, instead of being attached to the arms of the fan, as has been customary, is placed upon a substantial base. The motor before shipment is run under load and tested for temperature, commutation and regulation. The series-wound multipolar form is used except for the very small machines, which are bipolar. The open type motor, as here shown, which insures free ventilation and cool running, is usually furnished, but enclosed motors may be furnished when desired. The fans, either



ELECTRICALLY DRIVEN FAN.

medium speed or high speed, are made in sizes from 18 inches to 60 inches diameter, by the American Blower Company, Detroit, Mich.

ELECTRIC MOTOR.

The Northern Electrical Manufacturing Company writes to say that they think they are entitled to the credit of making the motor with which the Gisholt boring and turning mill, illustrated by us at page 911, is driven. The company states that it is one of its variable-speed motors, built on the two-wire single-voltage system, which enables such motors to be installed in existing shops without the necessity of duplicating the generating and transmitting system.

Personal.

Fred Harris has severed his connection with the Rand Drill Company, of which he was formerly sales agent in Butte and Salt Lake City.

Dr. Schuyler Skaats Wheeler, president of the Crocker-Wheeler Company, electrical manufacturer, sailed on July 13, with Mrs. Wheeler, on the White Star liner "Baltic."

Lyman B. Brainerd has been elected president of the Hartford Steam Boiler Inspection & Insurance Company in place of the late J. M. Allen. Mr. Brainerd has been connected with the company ten years, having been treasurer for five years. This office he will continue to hold with the presidency.

Louis Terven, E. E. (University of Wisconsin) has recently been appointed chief electrician of the Nernst Lamp Company, Pittsburg, Pa. Mr. Terven was for some time electrician of the United States Navy Yard, Port Royal, S. C., which position he resigned to enter the experimental laboratory of the Nernst Lamp Company.

It is announced that Prof. W. C. Unwin will immediately retire from his position as professor of Civil and Mechanical Engineering in the "Central Institution," with which he has been identified for twenty years with great honor to himself and advantage to the institution. It is proposed to found an Unwin scholarship as a memorial.

Obituary.

Charles Rowe, who died recently at Bridgeport, Conn., seventy-one years old, had been employed in the Wheeler & Wilson factory forty-seven years, with the exception of the time he served in the war, 1861-65.

Parley Williams died at Moline, Ill., July 8, seventy-two years old. Mr. Williams was born on a farm in Massachusetts, learned the machinist trade, and worked for some years at Barre, Mass. With two brothers he built a small shop at Moline, Ill., and by hard work they built up a prosperous business. Mr. Williams withdrew from the firm and for eight years was foreman of another works, retiring several years ago.

Samuel Milton Jones, inventor and manufacturer of the Acme sucker rod and other oil well machinery, but better known as the "Golden Rule Mayor," of Toledo, Ohio, died July 12, at his home in that city, from a complication of diseases, at the age of fifty-eight years. He was born in Wales and came to this country when a child, his parents settling in Pennsylvania. When eighteen years old he became engaged in the oil producing industry, then in its infancy. Inventing the sucker rod, he went to Toledo, Ohio, and established a factory for its manufacture. In Toledo he found labor conditions not to his liking, and for his part determined to improve them. He declared that the "going wages" rule should not govern in his factory. He lived up to his principles, and, besides paying his employees as good wages as he could, he less than three months ago gave them stock in the Golden Rule Trust, as his company is now called, to the value of $10,000.

Adolph Faber Du Faur, Jr., patent attorney, died at his home in Newark, N. J., July 12, 1904, aged nearly forty years. He was a graduate of Stevens Institute, class of 1884, and commenced his career as an assistant in the office of Van Santvoord & Hauff, 41 Park Row, and from the beginning showed great aptitude in all matters pertaining to patents and patent law. He commenced practise as a patent attorney in 1888 and continued the business at the same address until the time of his death. In the seventeen years of active practise, he secured many noted and valuable patents, among which were the Bristol recording instrument patents; counter-flow apparatus for the liquefaction of air; the Krupp process for hardening armor plates. This patent was only granted after years of work and not until all possible defense of the Patent Office had been exhausted. The granting of this patent has cost the United States Government millions of dollars; the royalties upon the first order placed by the United States Government within a year of the granting of the patent amounted to more than $300,000. Mr. Faber du Faur, Jr., was also a partner in the engineering business of Faber du Faur & Donnelly, mechanical and civil engineers, 132 Nassau street; this business was organized in 1897. In all his business relations he was earnest and painstaking and had endeared himself to his business associates and friends.

Business Items.

Dodge & Day, in conjunction with Ballinger & Perrot, architects, are proceeding with the work of rebuilding and extending the plant of the Victor Talking Machine Company, Camden, N. J. The shops are to be electrically operated and motor drives throughout.

At the annual meeting of the Lapointe Machine Tool Company, held at Portland, Me., on July 8, the following officers were elected: President, Jos. N. Lapointe; treasurer, J. Keyes Hall; secretary, Benjamin F. Levy. Business is very good with this company, especially on foreign orders. The offices are at 30 Atlantic avenue, Lewis Wharf, Boston, Mass.

By arrangement with the electrical engineers, Brown, Boveri & Cie., of Baden, Switzerland, the Crocker-Wheeler Company has secured their alternating current designs, patents and right to manufacture in America, and has retained them as consulting engineers. The Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories adapted to American practice.

Dodge & Day, engineers, of Philadelphia, have just completed the installation of the 340 horse-power Buckeye vertical cross-compound engine, direct connected to two General Electric 100-kilowatt, continuous-current, compound-wound generators. The same concern is at work on a three-motor, electrically operated locomotive crane for this company, to handle beams, angle-irons and other heavy structural material, for use in their new storage yard.

The De Beers Mines Company, Ltd., Kimberly, South Africa, has cabled an order for a third Westinghouse-Parsons steam turbine generating outfit of 1,500 kilowatts capacity for its power plant at Kimberly. The new turbine unit will operate at 150 pounds boiler pressure, 35 degrees superheat and about 23 inches vacuum. Taking into account the altitude of Kimberly, this would be equivalent

to about 27 inches vacuum at sea level. The new unit will be shipped *via* New York in about six months.

W. F. Warden, president and general manager of the Burt Manufacturing Company, of Akron, Ohio, has just returned from an extended business and pleasure trip abroad, having visited England, France, Germany, Switzerland, Norway, Sweden, Italy and Spain, calling upon the regular agencies of his company and establishing new ones. He reports that he has had a profitable trip, having formed many new and desirable connections while abroad, in addition to looking after the stock of the old agencies. While in England, Mr. Warden personally sold one of the large size Cross oil filters to Bryant & May, the English representatives of the Diamond Match Company. While in London, Mr. Warden secured an order from his British agents for 150 oil filters and exhaust heads.

The New York Brazing Company has been organized and has taken over the business of the American Brazing Company in New York State. The new company will have the exclusive rights for the use of Ferrofix in the State. A new and large plant will be secured for handling castings up to 50 tons. The old plant at 329 West Twelfth street, New York city, will be used for handling castings up to 5 tons. The offices will remain at 329 West Twelfth street. A number of prominent men in the commercial and financial world are connected with the company, the officers being as follows: President, Robert C. Pruyn, president of the National Commercial Bank of Albany; vice-president, Perry A. Rockefeller; second vice-president and treasurer, Robert Dunbar Pruyn, and general manager, Electus B. Ward.

Manufacturers.

H. J. Fowler, Keene, N. H., will build a box factory.

The building of the Fairbault (Minn.) Canning Company has been burned.

The Business Men's Association, Gloucester, Mass., is discussing a shoe factory.

The Goodspeed Machine Company, Winchendon, Mass., is building a new shop.

The Irving Cut Glass Company, Honesdale, Pa., plans for a new factory building.

An addition is to be built to the plant of the Owensboro (Ky.) Forging Company.

A 45x90-foot addition is planned for the Drummond boiler works, New London, Conn.

Nelson Morris & Co., Chicago, Ill., plan for a soap factory, six stories, 172x128 feet.

A tool house is being built by the Farrel Foundry & Machine Company, Ansonia, Conn.

The mill of the Rock River Cotton Company, Janesville, Wis., has been damaged by fire.

Five thousand additional spindles are to be installed at the Lancaster (S. C.) Cotton Mills, No. 3.

A repair shop is about to be built at Newberry Junction for the Philadelphia & Reading Railway.

W. F. Taubel, of Riverside, N. J., and elsewhere, is about to build a knitting mill at Reading, Pa.

The Cement Lime Brick Company has been looking for a location for a 50x150-foot plant at Schenectady, N. Y.

Milwaukee (Wis.) Street Railway Company will at once erect an addition to machine shops on Commerce street.

The Hansell-Elcock Company will build a foundry at Butler street and Archer avenue, Chicago, Ill., to cost $50,000.

Work has begun on additions to the plant of the International Acheson Graphite Company, Niagara Falls, N. Y.

The Truss & Cable Fence Company, Cleveland, O., has contracted for a new factory building at East Cleveland.

Cawley, Clark & Co., manufacturers of paints and colors, Newark, N. J., are starting to erect a 96x145-foot addition.

The Muskegon (Mich.) Milling Company is considering the advisability of enlarging its plant on Water street, that city.

The Modern Bedstead Company, Sherbrook, Que., manufacturer of iron bedsteads, etc., proposes to build larger quarters.

It is stated at Hibbing, Minn., that Herman Antonelli is at the head of a proposition to establish brick kilns near there.

B. T. Babbitt, the big soap manufacturing concern of New York, is preparing to erect an extensive plant at Granton, N. J.

The Brown Cotton Gin Company, manufacturer of cotton ginning machinery, etc., New London, Conn., plans for a two-story addition.

Kalamazoo, Mich., thinks it has practically secured the U-Pin-It Hook & Eye Company, of Chicago, Ill., and Janesville, Wis., for that place.

The Limestone Manufacturing Company, of Gaffney, S. C., is to double the present capacity of its mill, 13,500 spindles and 400 looms.

The Watertown (N. Y.) Marble Company plans for a new finishing building, which will be equipped with machinery. Cranes will be installed.

The Trio Manufacturing Company, which is operating 3,000 spindles at Forsyth, Ga., is contemplating the erection of another mill, to cost $50,000.

Considerable damage has been done by fire in a tipple and engine-house of the Altoona (Pa.) Coal & Coke Company, a few miles from Ashville, Pa.

Plans have been made for a roundhouse, turntable, machine shops, boiler-rooms, etc., to be constructed at Greenville, N. J., for the Pennsylvania Railroad.

A movement is on foot at Clinton, Wis., to incorporate the Smith & Holtum Manufacturing Company, brass and iron goods, and probably extend its business.

The Blue Grass Commission Company, Lexington, Ky., proposes to build a new mill with engine and boiler-room, 50,000-bushel elevator, warehouses, etc.

The Edwards Manufacturing Company, cotton goods, Augusta, Me., is establishing, or will establish, in the basement a new machine shop, about 100x60 feet.

A large sawmill of the West Yellow Pine Company, at Olympia, Ga., has been burned. The planing mill was saved. The sawmill will probably be rebuilt at once.

Palmer Bros. Company, New London, Conn., manufacturer of comfortables, has bought land on which it is believed that it will build an addition to its plant.

J. F. Burton and C. H. Oakes, of Oneida, N. Y.; W. J. Frisbie, of Camden, N. Y., and Geo. Frisbie, of Utica, are officers of a textile company which may locate in Dunkirk.

The R. O. Evans Company, manufacturer of school furniture, etc., Owensboro, Ky., plans for a two-story and basement addition, 200x60 feet, to its plant in Seven Hills.

Real Estate Agent W. K. Lyons, New Brunswick, N. J., has been asked by the representative of a boiler works to get it a site of about two acres on the Raritan River Railroad.

The citizens of Colusa, Cal., have raised $100,000 toward a beet sugar factory to be built there. The remaining $300,000 is to be furnished by San Francisco capitalists.

The plant of the Portland (Ore.) Woolen Mills is to be rebuilt on a new site at St. Johns. Four buildings will be erected, the main factory being 200x100 feet, two stories.

A large automobile tire factory is proposed by Cleveland, Akron and Barberton, O., capitalists, and Barberton has been inspected for a site. The proposed capital stock is $100,000.

The Weatherproof Sectional Pole Company, organized at Guthrie, Okla., is establishing a plant at Little Rock, Ark. The Chattanooga Machinery Company has built machinery for it.

Sub-estimates have been taken on a five-story and basement textile factory, with boiler- and engine-house, at Second and Westmorland streets, Philadelphia, for Thos. E. Brown.

It is stated at Pueblo, Colo., that the Colorado Fuel & Iron Company is to increase the rail mill of the Minnequa plant. Orders for the machinery have probably been placed by this time.

A car company has been negotiating with the people of Paris, Ill., and vicinity, relative to locating there. W. C. Amos, one of the directors, was reported as being in that city lately.

The King Construction Company, boilers, of Toronto, Ont., which recently removed a branch factory from Lockport, N. Y., to North Tonawanda, N. Y., plans for a considerable enlargement there.

The Indiana Chair & Furniture Company, of Indianapolis, will remove to Evansville in the near future. The plant there will be three stories in hight, 100x72 feet and will employ about fifty men.

The Harley Pottery Company, Nashville, Tenn., intends to increase its capital stock from $10,000 to $50,000, and to erect a factory having a capacity many times as great as that of its present one.

It is rumored that a site of twenty acres has been secured by the Gleason Works, manufacturers of gears and gear planers, Rochester, N. Y., on which they propose the construction of a new plant.

The stockholders of the Arcade Cotton Mills Company, at Rock Hill, S. C., have voted to increase the number of spindles. A new building will be put up for 11,000 spindles, 6,000 to be installed at first.

Estimates are being taken on a carriage factory for James E. Romig, at the northeast corner of Broad and Wood streets, Philadelphia, Pa. It will be five stories high, 37x104 feet, with a rear addition 27x36 feet.

John MacMillan and E. G. Bennett, of Denver, Colo., are said to be talking of establishing at Milwaukee, Chicago and New York plants for the manufacture of a cleaning compound mined from a mountain at Durango.

A movement is on foot at Wilkesbarre, Pa., to establish a $30,000 plant for the manufacture of a self-lighting gas fixture now manufactured extensively in Germany. Several local capitalists have become interested in the matter.

The West Point (Ga.) Manufacturing Company has awarded a contract for construction of a 1,100-foot dam across the Chattahoochee River for electrical power development, and will put in additional spindles and other machinery.

A concession for the establishment of a malt factory in Mexico may be, or has been, granted to Lic. Domingo Gomez, of 13 Cordobanes street, Mexico City. He has returned from a trip in the United States and secured Milwaukee parties to undertake the management of the plant. It is proposed to form a stock company in the United States with a capital stock of $200,000.

The McConnell Wheel & Mine Supply Company is opening foundry and machine shops at Uniontown, Pa., for a variety of work, the specialty being a mine car wheel, with chilled hub, tread, etc., invented by Edward E. McConnell, who is the general manager. S. W. Ward, of Uniontown, is president. The capitalization is $100,000. The company purchased an existing plant and thinks of adding a 262x60-foot building.

President Baer has awarded to the Link Belt Engineering Company, of Philadelphia, the contract for the construction of what is reported to be the largest coal storage plant in the world. It will be located at Abrams, on the main line of the Philadelphia & Reading Railway, near Bridgeport. The plant will comprise eight piles, with a capacity of 60,000 tons each. It will have a guaranteed receiving capacity of 14,000 tons in ten hours and a discharging capacity of 10,000 tons in the same time. The new plant is to be completed by January 1, 1905.

A Havana, Cuba, paper states that the directors of the Sunlight Gas Company met at the office of Senator Parraga, and Mr. Baumgarten was given power to select one of two sites for the manufacture of gas generators. It was decided to proceed to the erection of a calcium carbide plant, with a capacity of 3,000 tons yearly. Mr. Baumgarten has been instructed to leave at once for the United States and secure from the best experts and engineers plans and specifications, and he will advertise for bids from manufacturers of electrical machinery in the United States and Germany.

Arthur Klein, of the recently incorporated Syracuse (N. Y.) Cutlery Company, will go to Solingen, Germany, and bring over a large part of the equipment of one of the plants of that city. Among the machinery will be some that is used for the forging of razors according to a secret process almost unknown in this country. The proprietor of the company will come to Syracuse and turn his machinery and experience in for stock in the new company. It is expected that some expert workers from Solingen will also come, as individuals, however, not on contract, so as not to conflict with the provisions of the alien contract labor law. The directors of the Syracuse Cutlery Company have elected as president John Gardner, manager of the local plant of the Crucible Steel Company of America; vice-president, Arthur Klein; secretary and treasurer, George A. Newman, of the Syracuse Chilled Plow Company.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Estimates furnished on pattern work. Globe Pattern Works, Kalamazoo, Mich.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed; working drawings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Second-hand vertical boring mill, 60 or 72 in.; must be in good condition. Ft. Scott Mfg. Co., Ft. Scott, Kan.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

A director of methods for increasing machine shop output solicits engagements; vast experience; excellent record. Box 104, A. M.

Addressing machines without type; high speed; run by motor or foot power; write for the picture book. B. F. Joline & Co., 123 Liberty st., New York.

Wanted—To buy interest in established business, combining engineering and manufacturing; location southern New England. Lock Box 555, Wellsburg, W. Va.

Wanted—Presswork, stamping, experimental, tool and die work; anything in steel, brass, copper, tin. H. S. B. Mfg. Co., 68 Richardson st., Brooklyn, N. Y.

Steam Turbine.—A. B. Van Wegen, 21 W. Wilford st., Grafton, W. Va., wishes to correspond with capitalists or company who are interested in turbines; a 12 in. wheel, 25 buckets, ¾ in. wide, with 80 lb. steam boiler, at 3,000 revolutions per minute, gives 7 1-10 brake horse-power; the velocity of steam is all expended on the wheel.

For Sale.

For Sale—AMERICAN MACHINIST from 1892 to 1903. E. H. Fish, Paxton, Mass.

For Sale—One Sellers 8 ft. gap steam riveter, for 1 in. rivets; good as new; can be seen and tested at our works. Chambersburg Engineering Company, Chambersburg, Pa.

For Sale—Two 50 H.-P. General Electric standard type "L," three-phase, 220-volt, 24-cycle, alternating current motors; 800 R. P. M.; used only few weeks; absolutely good as new. Box 127, AMERICAN MACHINIST.

For Sale—An old-established pattern shop; excellent reputation; centrally located in New York city; equipped with up-to-date woodworking machinery; splendid opportunity for energetic party; selling because another line requires more attention. Address "Patterns," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Traveler—Special machinery and machine tools—desires position in United States or for Canada; good connections. Address Drawer U, Sarnia, Ontario, Canada.

CONNECTICUT.

Wanted—Position as superintendent or general foreman by a thorough, practical mechanic with 12 years' experience; age 39; member of A. S. M. E. Box 116, AM. MACH.

FLORIDA.

Mechanical draftsman, young man, with drafting and shop experience. Box 147, A. M.

MASSACHUSETTS.

First-class man on mill construction and equipment wants situation; 12 years foreman; understand concrete. Box 150, AM. M.

MICHIGAN.

Experienced foreman patternmaker, now employed, desires to change. Box 122, A. M.

NEW JERSEY.

Wanted—Position as toolroom or machine shop foreman; practical; good designer; 11 years as foreman; first-class references. Box 149, AMERICAN MACHINIST.

Designer and draftsman of special and automatic machinery, jigs, fixtures, etc.; 14 years' practical shop and drawing-room experience; any State. Box 139, AMERICAN MACHINIST.

Practical mechanic, aged 26, draftsman, technical education and special knowledge of drop forge business, accustomed to planning work, estimating and designing dies, employed at present with first-class drop forge concern as assistant superintendent, will make change for position offering opportunity. Box 138, AMERICAN MACHINIST.

NEW YORK.

Draftsman, mechanical, wishes position. Box 151, AMERICAN MACHINIST.

First-class mechanical draftsman wants to change position. Box 128, AMER. MACHINIST.

Superintendent or general foreman, capable, systematic and experienced, open to correspond. Box 143, AMERICAN MACHINIST.

Mechanical draftsman, graduate, 5 years' shop and 5 years' office experience, wants position. Box 142, AMERICAN MACHINIST.

Machine shop foreman wants position; has the best of references from good concerns. Address Box 145, AMERICAN MACHINIST.

Situation wanted as foreman or erecting engineer; experienced in high-speed engines, gas and automobile engines. Address S., care AMERICAN MACHINIST.

Expert systematizer, young man, 10 years' experience, shop and cost systems, reliable manager, desires new field to systematize. Box 146, AMERICAN MACHINIST.

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Classification indicates present address of advertiser, nothing else.

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The St. Louis Exposition—IX.

EDITORIAL CORRESPONDENCE.

THE BALTIMORE & OHIO EXHIBIT OF OLD LOCOMOTIVES AND REPRODUCTIONS CONTINUED.

The succeeding fifteen years were not bright ones in the history of the locomotive. Engines continued to be built, chiefly for hauling coal, but the general experience with them was very discouraging. Thus in 1821 the Hetton Colliery road was opened with five locomotives, but within a month or two three of them were discarded and the others were recommended for condemnation, and the experience of the Stockton and Darlington was not much better. The conviction had, in fact, become quite common that the machine was a failure. In appearance these years of effort were almost fruitless, but in reality they were quite the contrary, as during their course five improvements had been made, all of which were essential to any large development of the locomotive, and which, in fact, made the success of the Rainhill trial of 1829 possible. Looking back, it is easy now to see that the Rainhill trial was but the harvest day of the preceding seed time.

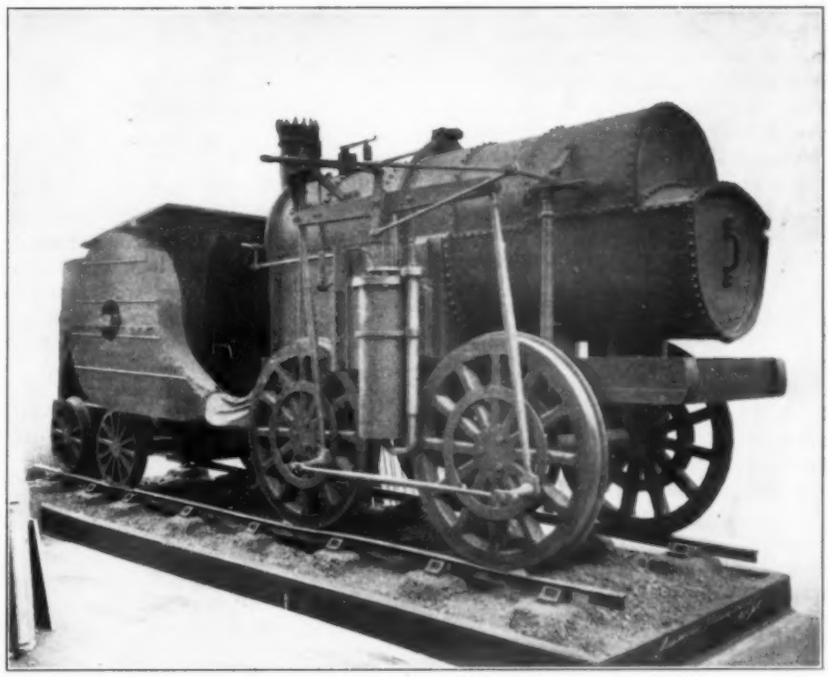


FIG. 9. THE "SEGUIN"—1827. THE FIRST TO HAVE A MULTITUBULAR BOILER.

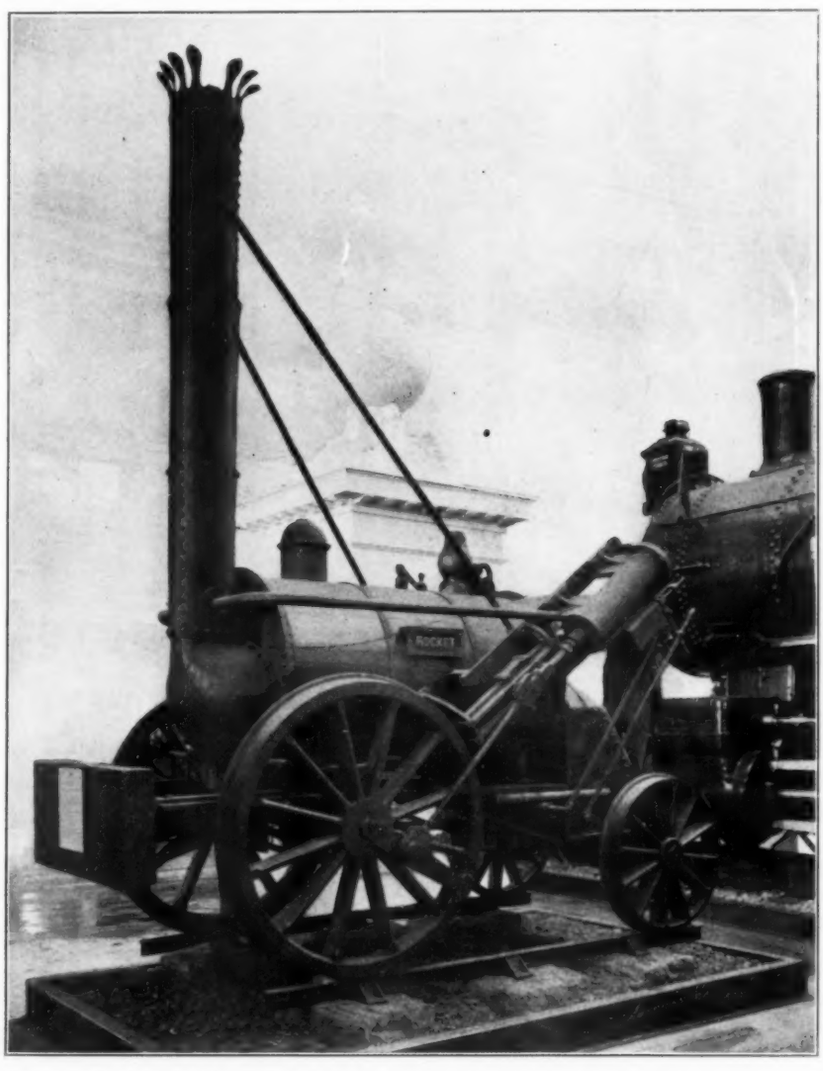


FIG. 10. THE "ROCKET"—1829. THE WINNER IN THE RAINHILL TRIAL.

These improvements were the parallel rod connection between the driving wheels, which was used by Stephenson on his "Locomotion" of 1825; the direct connection of the crossheads to crank pins in the driving wheels by connecting rods, which was used by Stephenson on the "Twin Sisters," also of 1825; the multitubular boiler, Fig. 9, used by Marc Seguin, of France, in 1827; the spring-loaded safety valve, used by Hackworth on the "Royal George" in 1827, and the exhaust in the stack, the property of which was discovered or rediscovered by Hackworth and applied to the "Royal George," in 1827. All of these improvements appeared at the Rainhill trial, the "Rocket," Fig. 10, having all except the spring-loaded safety valve and the parallel rods, and the "Sans Pareil," Fig. 11, having all except the multitubular boiler. In addition to this collection of improvements, the "Novelty" had a cranked axle and inside cylinders and the "Rocket" had spring support at the driving-wheel end and a lagged boiler, tho this latter had previously appeared on the "Puffing Billy." The discarding of the parallel rods by Stephenson on this occasion is explained by the fact that the "Locomotion," to which they had been applied, was intended for hauling heavy coal trains at low speed, while the "Rocket" was intended for light passenger trains at high speeds.

Of the wrong things in the early locomotives the vertical cylinders proved to be about the most difficult to get rid of—their persistence being due, no doubt, to the influence of the prevailing practise with stationary engines. Stephenson continued to use them down to and including the "Locomotion" of 1825, in which each cylinder was connected to its own pair of driv-

ing wheels in the manner in which Trevithick had connected one cylinder to one pair of drivers in the "Catch-me-who-can" of 1808. In order to secure the right angle effect Stephenson added return cranks to one pair of driving wheels with second crank-pins at right angles with the first and connected directly to the pins of the second pair of wheels by parallel rods—that is, the right angle relation was between the front and rear drivers instead of, as now, between the two sides of the engine. In the "Twin Sisters" Stephenson used, essentially, the present arrangement, except that the cylinders were inclined. The "Locomotion" and the "Twin Sisters" were thus two of the most important links in the development of the locomotive. In these two steps Stephenson eliminated the gearing and the vertical cylinders with overhead crossheads of the "Blucher" and adopted an arrangement which, except for the inclined cylinders, was essentially that of the outside cylinder of to-day. Unfortunately these engines are not represented at St. Louis. The horizontal, or approximately horizontal, cylinders followed immediately after the "Rocket" of 1829—appearing in the remodeled "Rocket" of 1830. With the vertical cylinders of the earlier engines spring support was obviously impracticable, and it was scarcely less so with the steeply inclined cylinders of the first "Rocket." It would seem altogether probable that the incessant action of the springs under the driving forces of the "Rocket" of 1829 led Stephenson to adopt the horizontal cylinders in remodeling that engine. It has become the fashion of late to look upon Stephenson as a copyist and appropriator of the ideas of others, but the above list of radically important steps made by him would indicate that his traditional position is more really correct than is the one taken by his detractors.

The Liverpool & Manchester Railway was the first to be projected as a railway in the modern sense—that is, as one intended to carry traffic for the general public. It was started with the avowed expectation that its motive power should be the locomotive and probably no industrial event in the history of the world ever attracted so much interest and attention on the part of the general public. As the day for its opening approached, however, the accumulating failures of the locomotive had almost caused the idea of its adoption to be abandoned. A committee of the directors visited various colliery roads where locomotives were in use in order to investigate the results that had been obtained, and their conclusion was unfavorable to their use. Two engineers to whom the matter was given for investigation reported in favor of dividing the road into sections and adopting rope haulage, and their report was approved by a third engineer. Finally, as a last and conclusive experiment, some of the directors prevailed upon the others to authorize a public trial of locomotives, the winner to be awarded a prize of 500 pounds sterling, and the result was the Rainhill trial of 1829, in which the "Rocket" was the victor and on which day the railroad era was opened at a bound. The reproduction of the "Rocket" at St. Louis, Fig. 10, stands upon rails which formed part of the track on which the Rainhill trial was conducted.

The other competing engines at this trial, the "Sans Pareil" by Timothy Hackworth, Fig. 11, and the "Novelty" by Brathewaite & Ericsson, appear at St. Louis beside the reproduction of the "Rocket." The originals of the "Rocket" and the "Sans Pareil" are preserved at the South Kensington Museum. Until recently the "Novelty" was supposed to have disappeared, but according to the *Scientific American* parts of it at least have been recently discovered.

Between the Rainhill trial and the actual inauguration of traffic upon the Liverpool & Manchester Railway important changes were made in the "Rocket" amounting almost to reconstruction, and the "Rocket" preserved in the South Kensington Museum is of course the "Rocket" that did service, and there are those who say that the reconstruction was so complete as to practically eliminate the original engine. Certain it is that the "Rocket" as it appeared on the day which made it forever the most famous locomotive in the world has disappeared. The reproduction at St. Louis was made from tracings from the original drawings which were supplied by Messrs. Robert Stephenson & Co., of Newcastle-upon-Tyne and represents the "Rocket" of the Rainhill trial.

The "Sans Pareil," which was unfortunate on the day of its trial by reason of a broken cylinder, due to a defective casting, has been more fortunate in its preservation and, in its original form, is now to be seen at the South Kensington Museum, being thus one of the very few pioneer locomotives which still exist in the forms in which they left the hands of their makers.

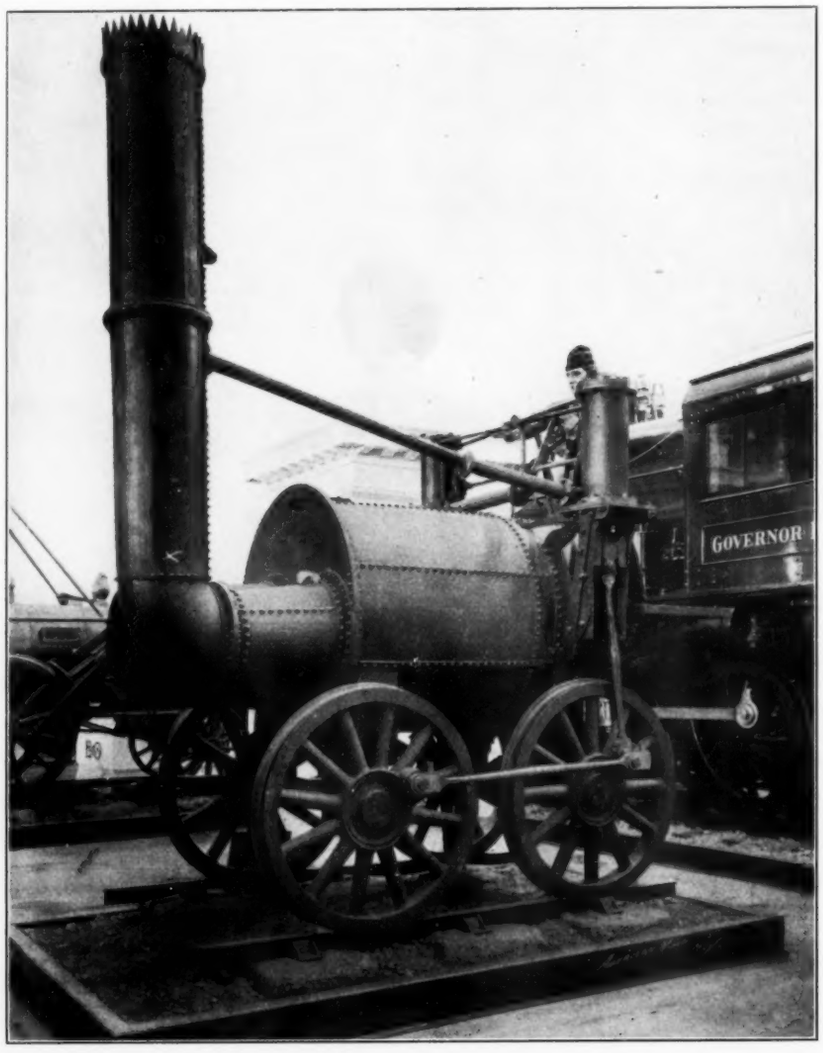


FIG. 11. THE "SANS PAREIL"—1829. COMPETITOR AT THE RAINHILL TRIAL.

One of the trials of the pioneers was due to the noise made by their engines, to which the public made great objection and against which acts of Parliament were directed. Part of this noise was due to the open exhaust, which, to quiet the noise, was turned into the stack, and without a

thought of its effect on the draft. As has been said, Hackworth was, bar Trevithick perhaps, the first to discover this effect, and with this in view he thus disposed of the exhaust of the "Royal George" of 1827. He did the same with the "Sans Pareil," but was unfortunate in his proportions. With the large single return flue of that engine the effect was to lift the fire from the grate and discharge it from the stack, to the terror and consternation of the spectators. Hackworth quickly recognized that he had too much of a good thing, which only needed proper regulation, and at once devoted himself to the matter and was the first to do this. Stephenson also placed the exhaust in the stack of the "Rocket," tho, apparently, without appreciating its effect on the draft. He was, however, more fortunate than Hackworth, his multitubular boiler so softening the blast as to keep the fire on the grate. The combination was no doubt a factor in the success of the "Rocket," for which it did not then receive credit.

While it may be possible that Stephenson understood the effect of the exhaust in the stack, it is quite plain that, altho it had been used for several years, its effect was not generally understood. Thus Seguin, when trying the engine with the first multitubular boiler, Fig. 9, in 1827, found the draft insufficient and added two fans attached to the sides of the tender and driven from the tender axle, and Ericsson used a fan in connection with the "Novelty," as did Peter Cooper with the "Tom Thumb," showing that while all understood the necessity for artificial draft, they did not understand the action of the exhaust in the stack, as, certainly, no one would employ a fan to do what he knew a simple blast nozzle would do as well. Neither the "Johnson" of 1830, Fig. 15, nor the "York" of 1831, Fig. 16, had the exhaust in the stack. It should be remarked also that the "Seguin" returned to the plug ro' valve gear.

If the reader will reflect that twenty-five years had been consumed in arriving at what now seems such an obvious arrangement as the parallel rods and outside cylinders with connecting rods between cross-heads and crank pins, he will appreciate how slow and laborious was the work of those early years. The Rainhill trial, however, found all the essential elements in existence, and progress then became as rapid as it had previously been slow. Stephenson's "Rocket" of 1829 was an operative assemblage of parts; his "Mercury" of 1830 was a well worked out design.

The same year as the Rainhill trial saw the importation into this country from England of the "Stourbridge Lion," Fig. 12. This engine was made by Foster & Rastrick, of England, and was imported by Horatio Allen for the Carbondale road at Honesdale, Pa., which was a horse tramway used for carrying coal from the mines to the Delaware & Hudson Canal Company's boats. Some parts of the original engine are now on exhibition at the National Museum, Washington, and a counterpart of it, the "Agenoria," built at the same time, is preserved in the South Kensington Museum. The rails of the Carbondale road were of hemlock timber, 6x12 inches, gained and keyed into cross ties spaced 10 feet part, and having strap iron secured upon them for the running surface. The form of track used in England at this time was still the cast-iron rail supported upon stone sleepers, as shown in Figs. 10 and 11, and the track used at Carbondale appears to have been among the first to use cross ties in any form. The weight of the engine was five tons, for which the track was entirely insufficient; but, nevertheless, Mr. Allen placed the engine upon the rails, fired it up and made at least a trial trip with it but without cars behind it. The engine was thus the first to turn a wheel in America. The reproduction shown was made from drawings prepared from the "Agenoria." The "Stourbridge Lion" was strikingly like the "Puffing Billy" in general appearance, but the gearing was omitted and the connecting rods engaged the driving wheels directly. Moreover, its wheels were connected by parallel rods and its valves were driven by eccentrics, and it was thus several steps nearer the engine of today than was the "Puffing Billy," tho it was of course far behind the "Twin Sisters," the "Rocket" or the "Sans Pareil."

FIG. 12. THE "STOURBRIDGE LION"—1829. THE FIRST TO MOVE UPON RAILS IN AMERICA.

Contemporary with the "Stourbridge Lion" was Peter Cooper's "Tom Thumb," Fig. 13. Mr. Cooper was a stockholder in the Baltimore & Ohio and was fully persuaded of the feasibility of the use of steam power upon it and made the "Tom Thumb" as a demonstration engine to convince others. The plans for it were made before any English engine arrived in this country and it was tried the same year as the "Stourbridge Lion," the trial being held just outside of the city limits of Baltimore. The result of the trial was some alterations, and on August 28, 1830, the "Tom Thumb" drew a car filled with the directors and officers of the road a distance of 13 miles and return, the outward time on an up grade of 18 feet to the mile being 1 hour and 12 minutes and the return time

57 minutes. The result of this trial was to end the controversy regarding the use of steam power in this country, as the "Rocket" had done the year before in England. Another American engine of the same year—1830—was the "Best Friend," Fig. 14, designed by E. L. Miller and built at the West Point Foundry. The "Tom Thumb" was built for demonstration purposes only, and the "Best Friend" was thus the first engine built for actual service in America. It was built for the South Carolina Railroad, on which it was placed in service and where it exploded its boiler in 1831. It was, however, rebuilt and renamed the "Phœnix." Of this same year should also be mentioned the "G. W. Johnson," Fig. 15, built in 1830, and entered in the formal Baltimore & Ohio competition of the following year. While not successful in the trial, the engine is noteworthy as being the first to have a double firebox and a boiler of the present locomotive type. The shape of the smoke-box would indicate that the boiler had several tubes, and it is certain that in its double firebox and general form it was the first locomotive boiler of the present type. In the "Seguin," it will be observed, the tubes were of the return type.

The winning engine of the Baltimore & Ohio trial of 1831 was the "York," Fig. 16, built by Phineas Davis, of York, Pa. While this engine won and received the prize of $3,500, it was by no means a successful engine as would now be expected from the peculiar arrangement of the connecting rods. It was thereafter very much modified by Ross Winans, and became the starting point of the Baltimore & Ohio motive power equipment.

Immediately around the "York" and "Johnson" are reproductions of the three other contestants at that trial, but as they neither won the prize or introduced new principles of construction, special illustrations of them are omitted, tho one of them is seen in the background of the illustration of the "York." F. A. H.

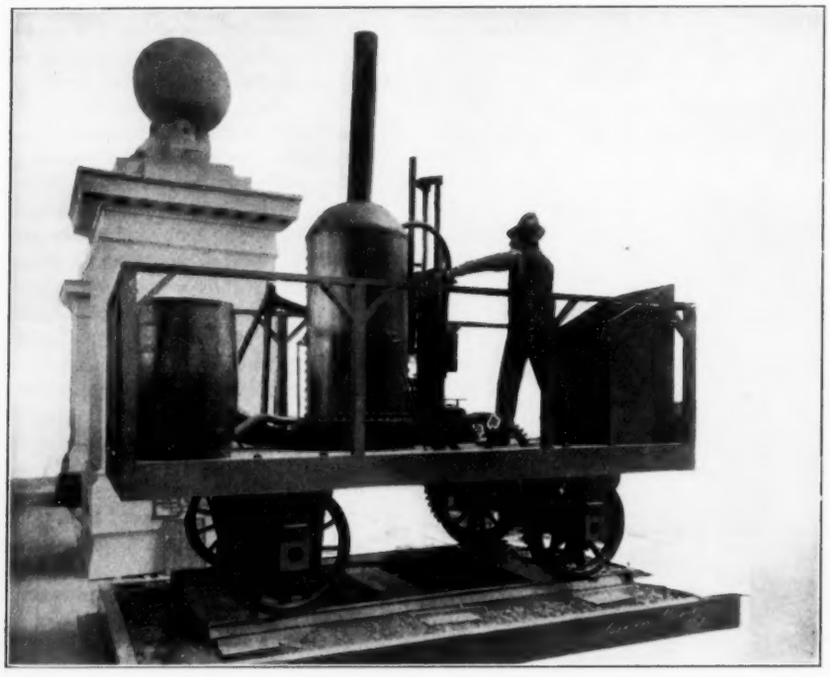


FIG. 13. THE "TOM THUMB"—1830. THE FIRST TO DRAW A CAR IN AMERICA.

FIG. 14. THE "BEST FRIEND"—1830. THE FIRST BUILT IN AMERICA FOR ACTUAL SERVICE.

At the New Home sewing machine shops at Orange, Mass., there are 170 men employed who have worked for the company twenty years and over, and there are four who have worked for the company forty years. This speaks well for men and company.

Legal Notes.

BY E. P. BUFFET, LL. B.

A PAROL AGREEMENT AGAINST AN EXPRESS WRITTEN STIPULATION.

The fact that parties to a contract stipulate therein that any subsequent modification thereof must be in writing in order to be valid, does not always preclude them from making a binding new agreement modifying the old one, by word of mouth alone, thus waiving the restrictive clause. Superficially this may seem to be in contradiction with well-known rules of law, and perhaps to common sense, but under some conditions at least it is possible. Such a stipulation was embodied in a contract by which the General Electric Company agreed with a contracting company to deliver by a certain date $65,000 worth of electrical machinery and other material for the Hudson River Power Plant at Spier's Falls. It appears that the General Electric Company could and would, if necessary, have shipped the machinery at the time appointed, but as a matter of mutual convenience it was orally agreed with the contracting company that the time should be extended. The outcome was that the contracting company refused to receive the machinery when it was ready, and the General Electric Company auctioned it off for $30,000. The New York Court of Appeals holds that the General Electric Company can recover from the contracting company damages amounting to the agreed price less the $30,000 and less also what it would have cost the General Electric Company to install and wire the machinery, which job was included in the contract; interest being allowed from the time of defendant's default.

It is necessary to note that under the circumstances of this case, time is held to be not "of the essence of the contract"—*i. e.*, not so vitally important that if one party fails to comply with the terms as regards time of performance the other party is justified in breaking off entirely.

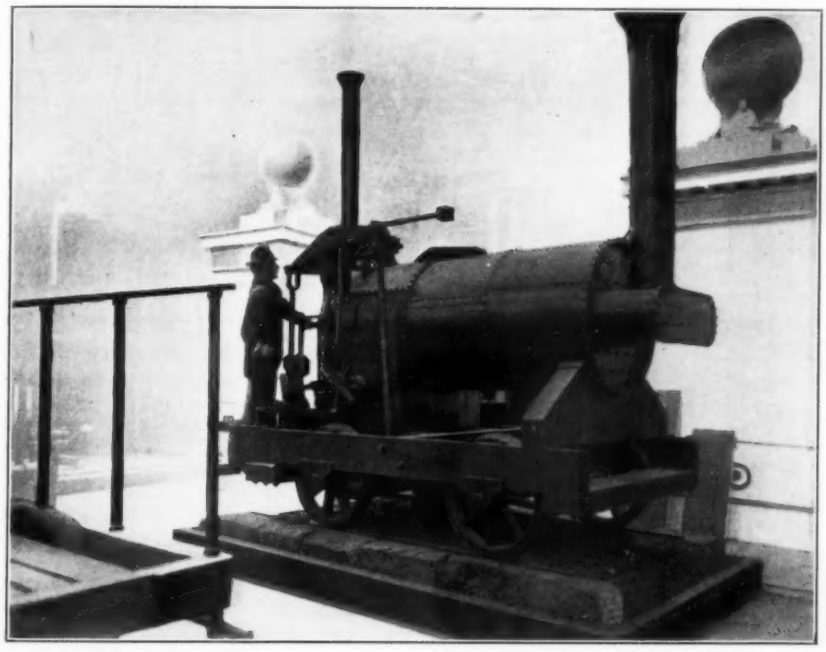


FIG. 15. THE "JOHNSON"—1830. THE FIRST TO HAVE A DOUBLE FIRE-BOX.

It is doubtful if an essential element of the contract could have been thus modified by parol agreement. 70 N. E. Rep., 928.

GUARANTY OF AN ICE MACHINE APPLIANCE.

The Pennsylvania Iron Works sold the Hygeian Ice & Cold Storage Company, of Fall River, Mass., an ice machine. To adjust some matter in connection therewith an additional contract was entered into, by which the Pennsylvania company agreed to deliver a 20-ton evaporating apparatus, which was made by a third concern; the ice company to return the part of the previously installed plant superseded thereby, and further to pay the Pennsylvania company the sum of $1,500 in one month, unless within that time the ice company gave notice that the apparatus failed to accomplish the results guaranteed by the company with which the Pennsylvania Iron Works contracted to furnish it, and requested its removal. It was also stated in the contract that the month's interval between delivery and payment was given in order for the defendant to determine whether the appliance was of 20 tons capacity, as agreed on.

The ice company expressed some dissatisfaction with the new apparatus and efforts were made to improve it so that it might produce better ice; but notice was not given to remove it, nor does it appear that the capacity fell short of 20 tons.

Under these circumstances the Supreme Judicial Court of Massachusetts holds that the ice company had no right to withhold payment at the end of the month. Says the court: "The plaintiff [Pennsylvania Iron Works] did not guaranty that the apparatus would furnish merchantable ice, free from impurities and odors, or that it would work satisfactorily in connection with the ice-making plant already installed. Indeed it would seem from the correspondence . . . that the plaintiff [Penna. Iron Wks.] did not believe that the . . . apparatus would accomplish the results desired, and that the defendant [the ice company] was content to take the risk." 70 N. E. Rep., 427.

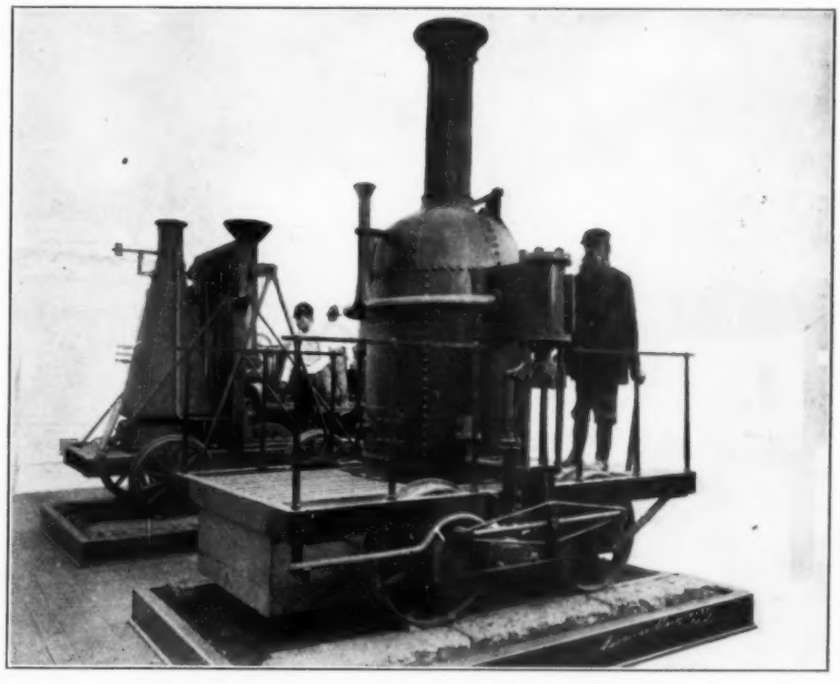


FIG. 16. THE "YORK"—1831. THE WINNER AT THE BALTIMORE & OHIO TRIAL.

WHERE A STOCKHOLDER CANNOT SUE AT LAW.

The United Shoe Machinery Company and three personal defendants were sued at law for alleged conspiracy to injure and ruin another corporation, the Guddu Sons Metal Fastening Company, the action being brought by a stockholder in the latter company. The averments of the declaration were in substance that the three personal defendants had "conceived a plan of acquiring, by purchase or otherwise, the control of said Guddu Sons Metal Fastening Company, and of absorbing its rights, patents and other property into the said United Shoe Machinery Company," of which they were officers and directors, and that afterward, combining and conspiring with the defendant corporation to injure the property of the other corporation, they acquired a majority of the stock of this other corporation, and elected themselves directors and officers thereof, and, as such officers and directors, were guilty of various misfeasances in the control and management of the corporation, greatly to the injury and damage thereof and of the plaintiff's share and interest therein.

To this the defendants demurred (*i. e.*, took issue on points of law). The Supreme Judicial Court of Massachusetts sustains their contention and holds that the plaintiff, as a stockholder in the Guddu corporation, had no right to bring the action. Her proper remedy would have been thru a suit by the corporation itself or by a bill in a Court of Equity.

The truth or falsity of the allegations on which this action is based remains, apparently, undetermined. 70 N. E. Rep., 444.

The Development of a Remarkable Turret Lathe.—I.

EDITORIAL CORRESPONDENCE.

With the Hartness flat turret lathe as built since 1891 by the Jones & Lamson Machine Company, most readers of the AMERICAN MACHINIST are thoroughly familiar. And with the latest design of the machine—which embodies the cross-feeding head and other unique features—they have recently been made acquainted, this machine having been at pages 585 and 845 quite fully illustrated. Leading up to the present construction some exceedingly interesting and important work has been done at the home of the "flat turret" in the way of developing a conveniently controlled and reasonably compact mechanism for imparting to the spindle a considerable number and range of speeds and to the turret slide a wide feed variation. And with the aid of numerous photographs and drawings it is my intention to describe some of the different stages of the development along this line as represented by various flat turret lathes leading from the machine of '91 to the present model, and all in operation to-day in the shops at Springfield, Vermont. These machines, it will be understood, are not "on the market," but they ought to be very interestng to all who have to do with machine-tool design or construction.

It will be recalled that in the recent description of these shops brief mention was made of a number of flat turret machines with the tools operated hydraulically, and a line of such machines was shown in one of the views illustrating the screw machine department. In the present article the first machine considered will be one of these hydraulics—the first flat turret lathe constructed in which the carriage feed was derived by means other than belt cone, splined feed rod and apron gearing. Prior to the construction of this machine, Mr. Hartness for some time had had under consideration the possibilities of apparatus actuated by fluid under pressure as a means of varying the feed of the turret slide, without the intervention of geared mechanism; and in 1899 his ideas along this line were embodied in the turret lathe represented in Fig. 1. In this machine were incorporated also hydraulic feed for the cutting-off tool and pneumatic control of the chuck and roller feed; and the ma-

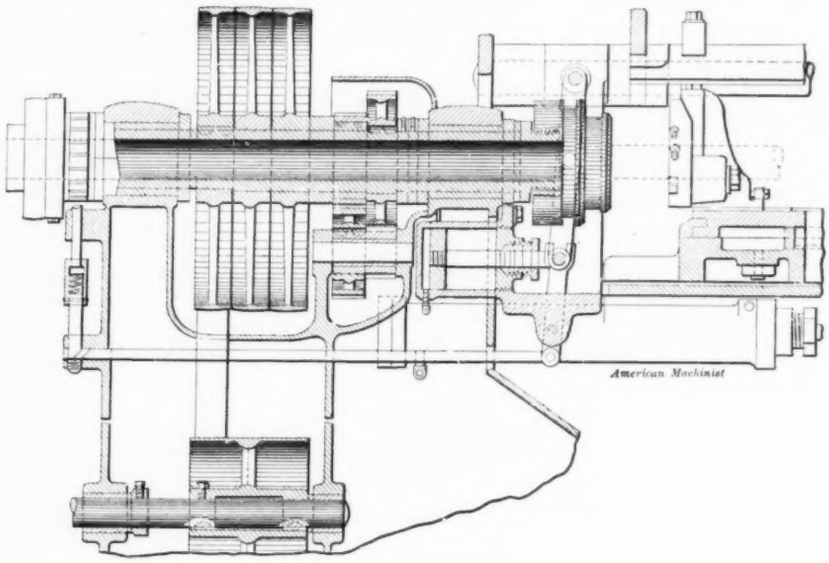


FIG. 2. SECTION THRU HEAD AND SPINDLE OF FIRST HYDRAULIC.

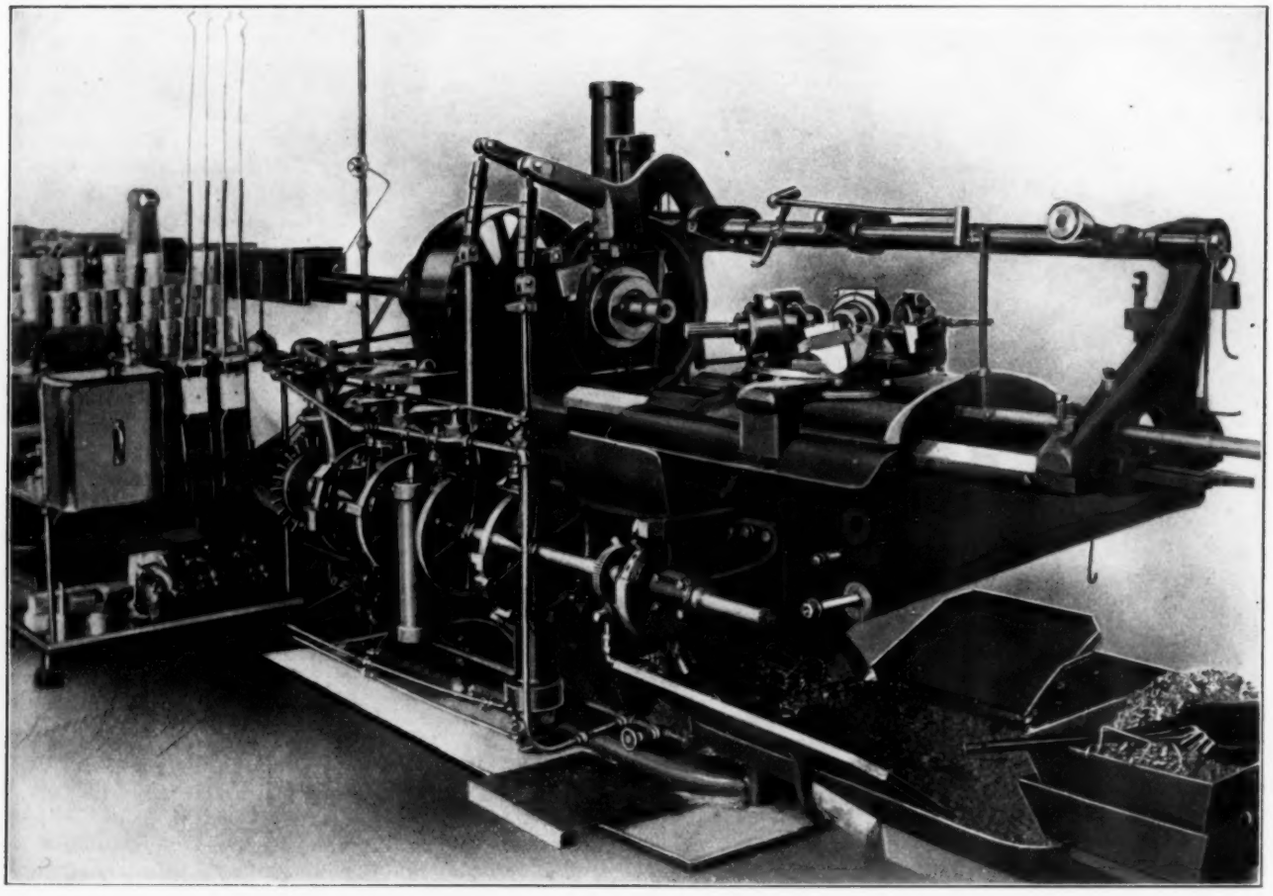


FIG. 1. THE FIRST FLAT TURRET LATHE WITH HYDRAULIC FEED FOR TOOLS.

chine as originally built was full automatic, the turning tools being closed and opened without the assistance of the operator. However, at the time the machine was photographed it was set up as a semi-automatic, the attendant swinging the tools open and shut and controlling by hand certain of the turret slide movements.

The machine is a 2½x25-inch; and, as will be seen by inspecting the sectional view of the head, Fig. 2, the spindle carries three narrow pulleys and is driven by a single belt from the drum below. Back gears are arranged in the manner represented, and the driving belt is shifted automatically along the face of the drum to actuate the back-gear pulley to the right or to drive the spindle direct thru the pulley to the left, the intermediate pulley running freely upon the spindle. At first and experimentally the machine was driven by an automobile steam engine connected by sprocket chain and operated by compressed air. It could of course be driven in either direction. Like many other tools in the same shop, the machine is now driven by a variable-speed motor, and the speed changes, aside from those derived from the back gears, are obtained by means of the controller attached to the stand at the end of the machine.

The hydraulic cylinder carrying the piston for operating the turret slide is secured in the bed in the position shown, and the piston rod extending rearward is rigidly attached to a lug depending from the under side of the slide. The two tanks

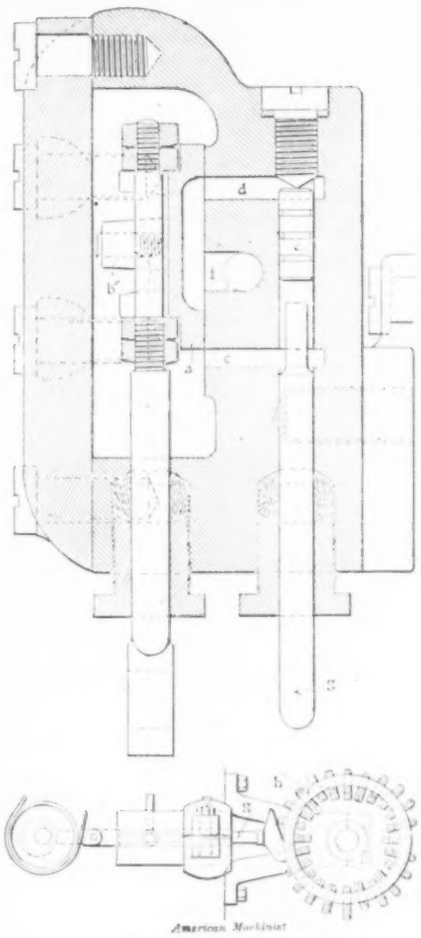


FIG. 3. THE METER.

supplying oil to this cylinder are placed at the rear of the head, as in the photograph, a third receptacle containing the liquid for the cut-off cylinder, which is located in a vertical position at the front of the bed, and whose piston rod, extending upward, is connected by a form of turnbuckle with an arm hung at the rear end on a shaft supported in brackets attached to the bed. This arm carries in a slot in its side the cutting-off tool, and immediately to its left is a second arm with its own cylinder and piston designed for swinging down the stock-stop and the tool-closing device. Both arms are counterweighted at the rear to hold them normally in their upper positions, pressure therefore being required only on the upper side of the operating pistons.

The valves controlling the movements of turret slide, cut-off, chuck and stock-stop pistons are placed at the front of the head and may be operated by hand, or automatically through the medium of the cam shaft below, the lower end of each stem having an arm which is thrown to and fro at predetermined intervals by contact with the adjustable cams. The shaft referred to carries also a disk with adjustable dogs for operating a belt-shifting device under the head, and has at its extreme upper end a disk with a series of stops for varying the feed by governing a meter or regulator (to be explained later) which at each stroke measures out a small amount of liquid and allows it to pass to the cylinders. The shaft is rotated inter-

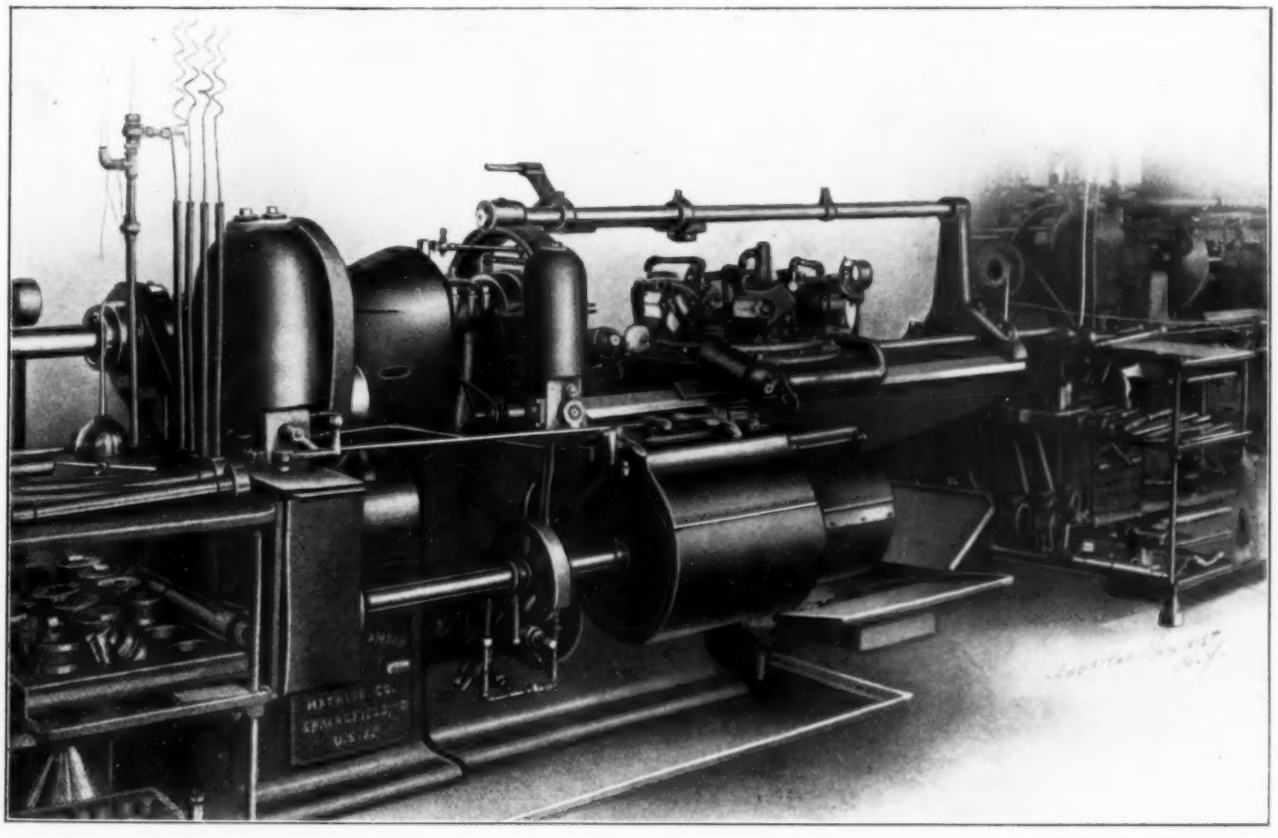


FIG. 4. HYDRAULIC WITH FRICTION HEAD.

mittently—its movements corresponding to those of the tools, so that it makes one complete turn to each rotation of the turret—by an air-operated motor concealed by the bed. This motor, while under a certain air pressure constantly, is prevented from running continuously by a series of stops carried by disks on the cam shaft. The stops are engaged, one after another, by a form of pawl or latch, and until the latter is lifted shaft and motor must remain stationary. Upon the release of one of the stops, the shaft is instantly turned ahead until the stop next in order is caught and held by a latch. The shaft is released when the machine is working automatically, by the slide as it reaches either end of the stroke and by the movement of the cut-off tool and stock-stop pistons.

Besides releasing the cam shaft at the proper time by operating mechanism attached to one of the locking pawls or catches, the turret slide is adapted to turn one of the valves independently of the shaft itself. This valve is arranged to direct the liquid either to the meter or else directly to the turret slide cylinder; and as there is always air pressure of about 90 pounds per square inch on the liquid in the operative tank, it follows that when the valve is open to the cylinder the piston and turret slide are moved quite rapidly. Such is the case, for instance, when the slide is returning after a cut has been taken and when running forward again to bring another tool to the work. Now, to reduce the rate of travel as the tool approaches the stock, it is necessary to shut off the direct passage to the cylinder and allow the oil to be fed thru the meter and thence behind the piston. The different tools, of course, require to be slowed down at different distances from the chuck, and to accomplish this six notched stop-bars, like those under the turret slide, are carried in a holder which is hung at the front of the bed and connected by a rod with the regulating valve handle. Six vertical pins supported by dogs bearing against the turret periphery are carried in the turret slide; and, as the turret rotates, these pins drop, one after another (the supporting dogs sliding back into pockets in the turret), and engage the notched bars below as the work is approached and cause the valve to be turned to throw in the meter feed. In a somewhat similar manner the cam shaft at the front is released to shift the valve again when the turret slide comes up against one of its six "knock-off" stops upon the completion of a cut.

As already noted, there are two oil chambers or tanks for the turret slide cylinder—one for each end—and one tank for the cut-off cylinder. Air pressure, as stated, is kept in the tank supplying liquid to the working side of either piston, and at the end of the stroke the pressure is removed, the air in the tank allowed to exhaust and the oil permitted to return through a check valve; thus in the case of the turret slide cylinder one of its tanks contains oil under pressure while the other is admitting the returning fluid, the conditions being reversed, of course, at each stroke of the piston. The one valve governs entirely the working of this piston, this valve being so constructed and so located in a system of piping as to regulate the flow of both liquid and compressed air whether to or from the tanks; and, according to the position in which the valve

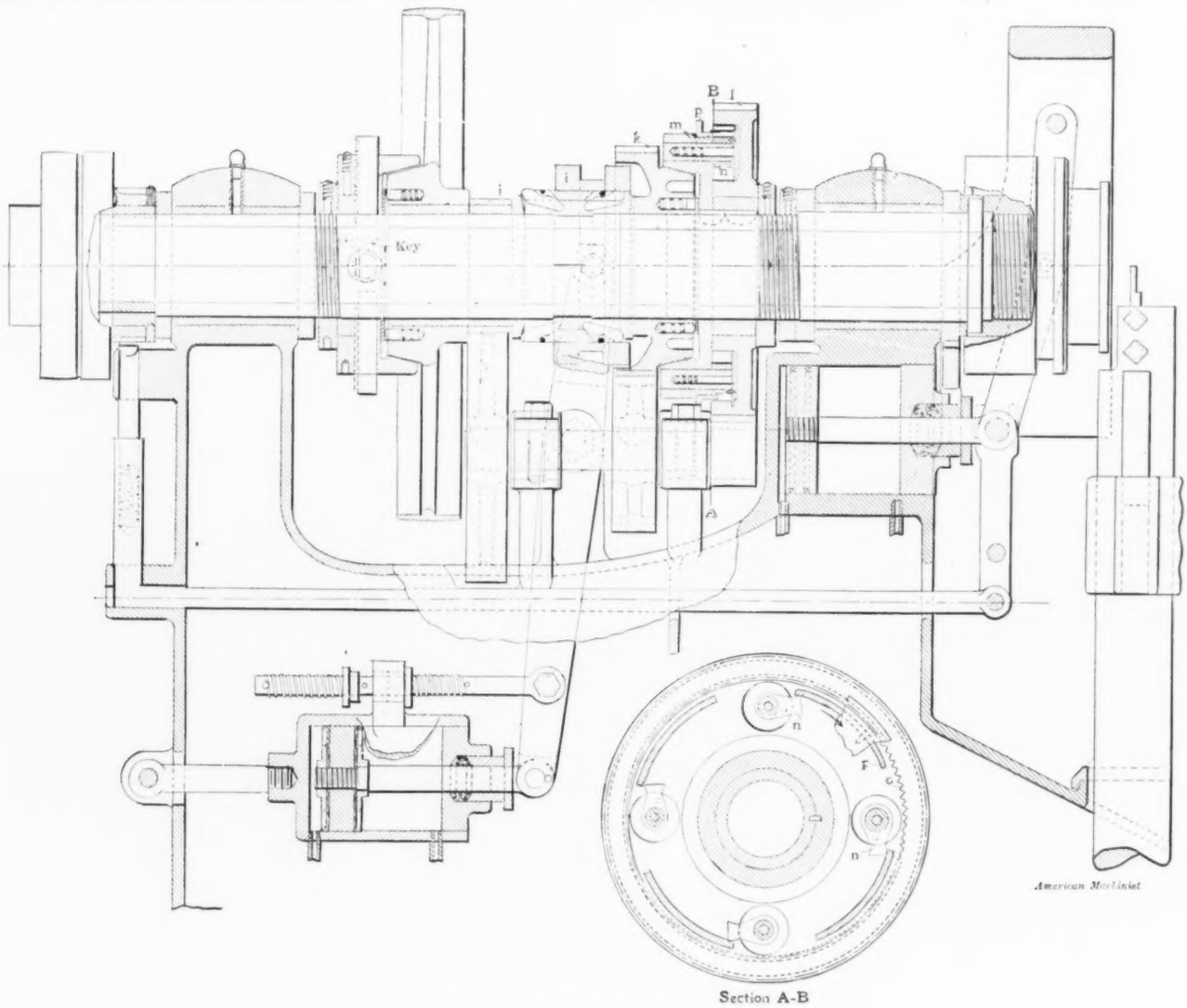


FIG. 5. SECTION THRU FIRST HEAD.

handle is set, the turret slide is fed forward or back, at full speed, or at working feed thru the medium of the regulator or meter.

The meter in its simplest form, and as applied to the first machine, is shown in Fig. 3; and while the construction of the device has been changed in the later hydraulic lathes the principle remains the same. As indicated in the sketch below the sectional view, the affair is attached to the end of the bed and is belt driven; and part *a*, which is in the form of a slide valve, is constantly and rapidly reciprocated by means of the eccentric so long as the spindle of the lathe is in operation. When the valve controlling, say, the turret slide movements is turned to a certain position, the oil from the tank is forced direct to the meter chest thru opening *b;* then alternately thru ports *c* and *d* it reaches the ends of piston *e*, which is consequently forced back and forth, measuring out at each stroke a small amount of liquid and forcing it by way of the exhaust passage *f* to the cylinder under the turret slide. The stop rod *g* is automatically adjusted by the device *h* at the end of the controller shaft and may be moved, as the shaft turns, to allow piston *e* any stroke required up to about 1 inch. The meter piston *e* is very small as compared with the piston operating the turret slide, and it is obvious that very sensitive feed regulation is possible; also that there is no possibility of the turret slide piston kicking back, the pressure against it being steadily and smoothly maintained.

The next hydraulic (constructed early in 1901) is shown in Fig. 4. This is a 3x36-inch machine with a single driving pulley for the spindle belted from a variable-speed motor below. The cylinders and pistons for the turret slide and chuck are arranged as in the earlier machine, but the cut-off tool is here carried by a piston working in a vertical cylinder as indicated in Fig. 5. The oil tanks and meters, it will be noticed, are mounted at the front of the head and the mechanism on the valve controlling shaft is nearly all enclosed. Two air cylinders are fitted to the end of the carriage in this construction to enable the tools to be closed automatically if desired; and the stop bar for the stock is so designed as to allow a post on the turret to swing it down into line with the spindle just before the chuck is opened. The friction head is controlled by cylinder and piston located as shown in the sectional view.

Reference to this drawing will show that for each speed of the motor shaft the spindle has three rates of speed. One of these —the highest—is obtained when the piston rod is moved to the right to slide ring *i* to the left, and by means of the cone friction, to clutch the pulley to the spindle, this pulley being keyed on the hub of a gear *j* which fits freely on the spindle. The back-gear shaft below, which is always running when the driving pulley is in motion, drives the loosely mounted gears *k* and *l;* and with the sliding ring *i* in the position indicated the intermediate speed is secured. With the ring in mid-position gear *k* is unclutched from member *m* which is keyed to the spindle, and the latter is then driven at the lowest rate of speed, thru the pinion on the back-gear shaft and large gear *l*, the latter being connected to *m* by means of a pawl and ratchet. Here is where the silent pawl used in the present flat turret lathe was first employed, it being made reversible in the case under consideration as the same set of gears drive the spindle in either direction.

In the section on line *A B* the four pawls are shown in place at *n*. They are carried by pins in the face of clutch *m*, and a thin disk dowelled at the back of each is pressed by a spring against a ledge formed in the annular recess in the side of gear *l*. Now, if the spindle is to be driven thru the slow gear, both frictions being disengaged, gear *l*, as it turns ahead, rotates the pawls thru contact

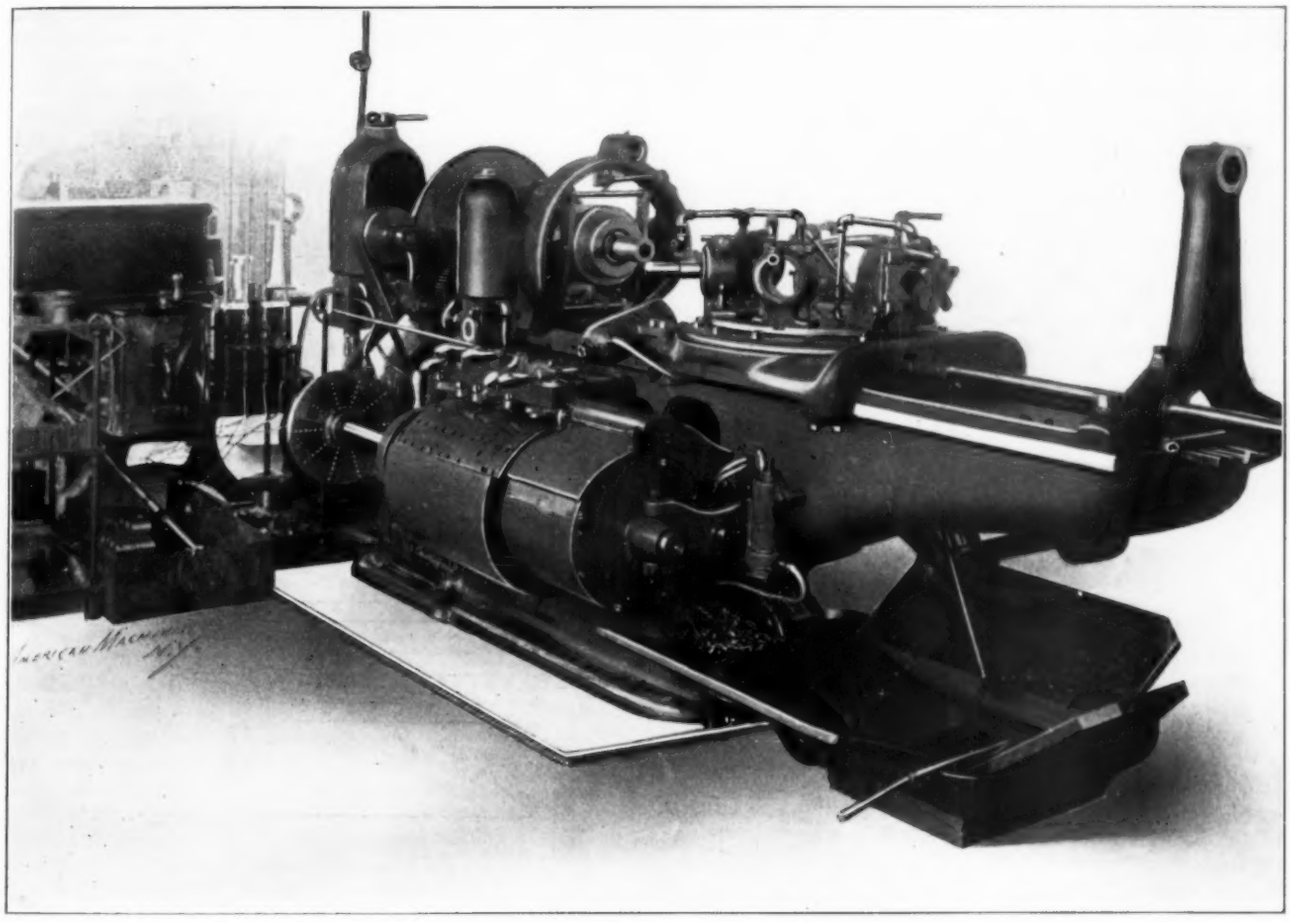


FIG. 6. HYDRAULIC WITH FRICTION DISK DRIVE.

with the outer edges of their disks, and swings their ends into contact with ratchet *o*, thus connecting *l* and *m*. Similarly, in reversing the direction of the drive, the pawls are swung up in the opposite direction and into contact with the same ratchet. The ends of the pawls, in order to reach the ratchet teeth, swing up through openings in a guard ring *p* carried by *m* and driven by a small pin passing through a short slot cut through the ring. The lower edge of the flange on this ring is always in frictional contact with a stationary shoe held in the head; and when one of the faster spindle drives is employed, the ring is simply slid back (relatively to its carrier) a distance sufficient to prevent the pawls, as they are turned back, from swinging up thru the openings and against the ratchet teeth.

were included in the design, these being arranged as clearly shown in the drawing. The large disk, which takes the place on the spindle occupied in the earlier design by the belt pulley, is 20 inches in diameter, and the small driving disks about 7 inches. The driving shaft is obviously the middle one of the three passing thru the base. The friction clutch on this shaft is very similar to those in the latest form of head, and is so arranged that when the driving gear for the lower shaft is clutched, the driver for the upper shaft is free, and *vice versa*. The belt leading over the pulleys in the fashion represented, it follows that the spindle can be driven in either direction by simply operating the clutch to make the required pulley below the driver. The mechanism for shifting the disks to vary

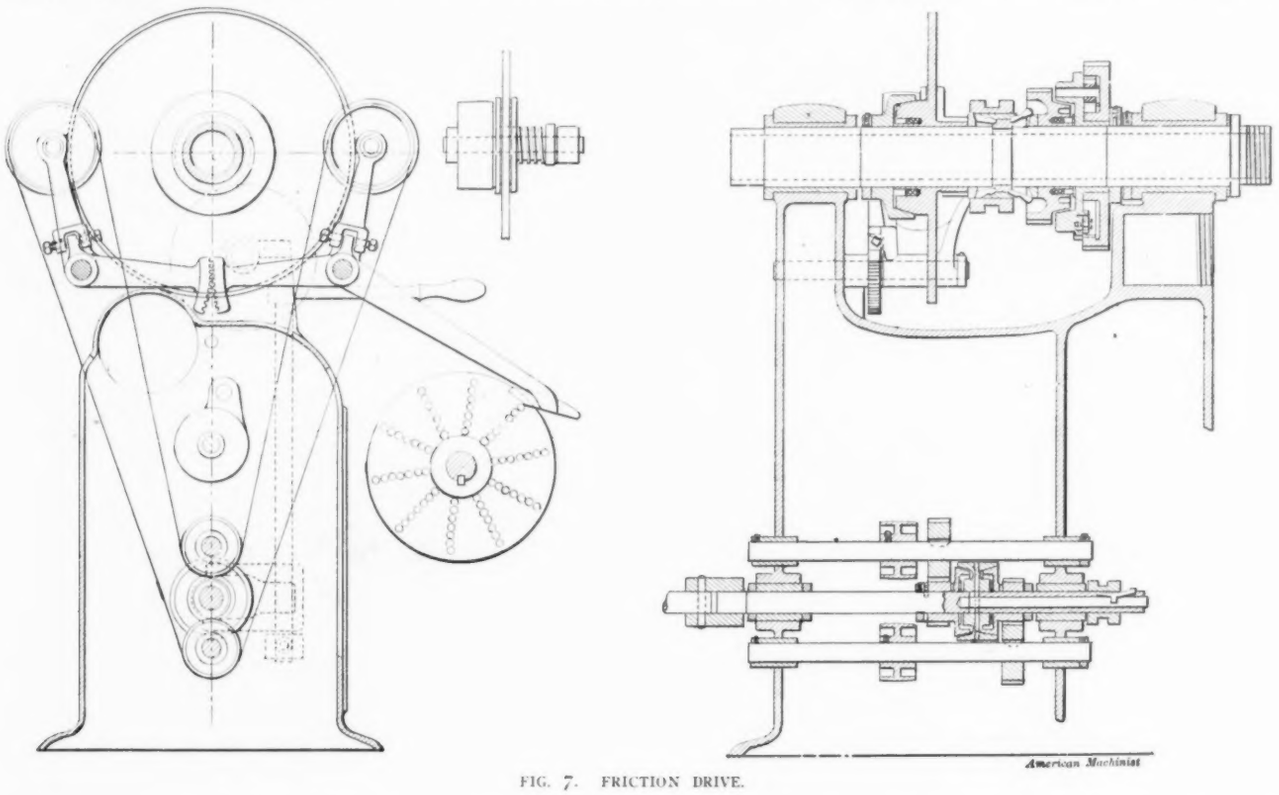


FIG. 7. FRICTION DRIVE.

In this machine was first used also the present type of rack and gear for rotating the turret, this arrangement, as explained in the article on the new model machine, starting the turret slowly and bringing it to rest without shock.

Following the construction of this hydraulic lathe, another was built on precisely similar lines, with the exception that the automatic controlling features were left off. Then, early in the following year, was built the machine illustrated in Figs. 6 and 7, this having the same hydraulic features as the one represented in Fig. 4, and the same simple and efficient geared mechanism for the spindle; but to make possible a large number of speed changes and yet admit of the employment of a plain pulley or a constant-speed motor for driving, friction disks the speed is brought out clearly in the drawing, and needs no explanation whatever.

F. A. S.

The excavations at Pompeii have brought to light a piece of bronze wire rope nearly 15 feet long and about 1 inch in circumference. This rope is now in the Musio Borbonico, at Naples.

Interesting statistics are given out of the application of the Pintsch system of lighting. The figures show that 130,000 cars, 5,800 locomotives and 1,700 buoys and beacons are equipped with the system, and 372 gas works are in operation to manufacture gas for it. In Germany 45,200 cars and 5,583 locomotives are lighted by the Pintsch system, the United States come second with 23,500 cars, and England next with 21,100 cars.

Obtaining the Motion of a Gun During Recoil.

BY SIR C. PURCELL TAYLOR, BART., D. SC., M. A. I. M. E.*

The editor of the AMERICAN MACHINIST has suggested to me that an account of certain methods of determining the motion of a gun during recoil, would be interesting. I must, in the first place, explain how these experiments became necessary.

In 1889 a quick-firing gun was designed for field use, which should be semi-automatic in action; that is, that the motion of recoil should be utilized to open the breech block to allow the shot and cartridge to be inserted by hand, after which the breech block was to be closed by the recoil motion.

This, it will be observed, left the principal part of the loading to be done by hand; all that could be done by the recoil motion was the opening and closing of the breech.

At first the breech was intended to be opened during the backward motion; but this would have allowed so terrible a blast of gas to escape backwards that it was evident the breech could not be opened till after the recoil was ended and the gun had begun its forward motion to its original firing position. All the motion, then, of the backward travel of the gun was idle, and the power had to be stored in a spring or similar device, to be given out either during the forward travel of the gun or after it came to rest. Thus it was arranged that the breech was opened during the forward travel, while

*Consulting Engineer to the French and Chilian Governments.

the loading and closing of the breech was effected after the gun had returned to the firing position. This necessitated the compressing of a very strong spring by the backward recoil, and the position of the spring became a matter of importance. If the spring could envelop the gun, the action and reaction would be purely central; but, as it was desirable to place the spring underneath the gun and at a little distance away from it, the two forces formed a couple with a considerable length of leverage, the distance from center of bore to center of spring being at least 12 inches. This would obviously tend to make the muzzle of the gun jump upwards, and as this jump would interfere with the accuracy of the trajectory, it became of the greatest importance to ascertain precisely what movement did take place, and when.

No such investigation had ever been made, and nothing whatever was known about the motion of recoil. All was unfounded speculation, and whatever information we desired would have to be determined by experiment. It was not easy to decide what line the experiments should follow, but eventually I worked out the following scheme:

Electric glow lamps were to be placed on the salient points of the gun. These being illuminated at the time of firing would enable a camera to record the motion.

The arrangement of the lamps is shown in Fig. 1. The gun was mounted on its carriage, and six lamps were affixed, one at each end of the gun, one in the middle of the gun, one on the recoil cylinder, one on the axle of the wheel, and one on the rim of the wheel at the top. These are denoted by little crosses in Fig. 1.

The lamp bulbs were about ¼ inch in diameter. They are very much used for electric toys and can be obtained very cheaply. They were lighted by a small battery of Bunsen's cells. Another battery was employed for firing the charge, and a third battery was used to operate the shutter of the camera. It may be thought that one battery would serve, but it was considered best to arrange three distinct circuits, to ensure reliable results by testing each piece of apparatus separately immediately before the experiment took place.

The camera was placed several yards away from the gun, to insure that it should not be disturbed by the vibration caused by the explosion of the powder. A screen was erected near the muzzle of the gun to cut off as much as possible of the light caused by the flash, so that the sensitive plate might not be fogged. As the experiments were carried out at night, there was no need for any other precaution.

The lens was an ordinary portrait lens of the Petzval pattern. The shutter was a simple drop shutter, consisting of a mahogany frame fixed on the hood of the lens, with a slip of ebonite falling down a groove. I added a small electromagnet and anchor escapement device which will be readily understood by reference to Fig. 2. It will be seen that while the current is passing, the anchor pallet holds up the lower pin on the shutter and keeps the lens closed. A small spring is fixed on the shutter mount, so as to bear against the magnet end of the pallet; and the spring is strengthened by a screw which can be turned so that the spring is just a little weaker than the pull of the magnet. This is to insure a quick break.

As soon as the circuit is broken, the

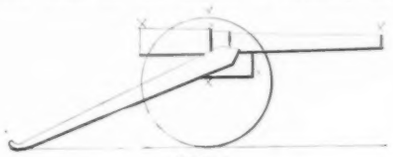


FIG. 1

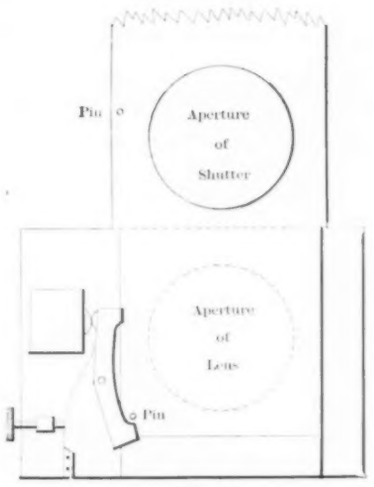
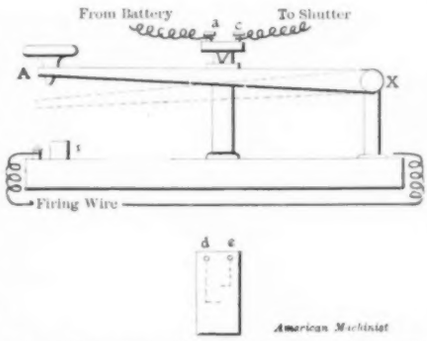


FIG. 2



OBTAINING THE MOTION OF A GUN DURING RECOIL.

anchor pallet is forced round clockwise so that the lower pin is released, allowing the shutter to fall until the upper pin comes down on the upper limb of the pallet. The aperture in the shutter then coincides with the lens and the plate is exposed.

The magnet on the shutter is a very small affair, only ⅞ inch long over all; and it is very quickly magnetized and demagnetized; the construction is the same as is employed in my chronograph, the Zamanap.

The firing key is shown in Fig. 3. It was adapted from a Morse key. *A X* is the lever, which controls two separate circuits, one for operating the shutter and one for firing the gun. The current for the control of the shutter is brought to a point *d* on a small insulated bridge of ebonite placed across the key, and the contact for return current to shutter is placed beside it at *e*. The ebonite bridge is supported by two pillars, of which only the farther one is shown in Fig. 3. On the lever is placed a small insulated strip of metal which, when the lever is in its normal position of rest, as shown in the full black lines, touches the two contacts *d e* in the bridge just referred to. From these contact points fine wires are led thru the thickness of the bridge (as shown by the dotted lines) to the terminals shown above, from which wires pass to the battery and to the magnet fixed to the shutter, as shown in Fig. 2.

That is one of the circuits that the firing key controls. The other is the firing circuit itself. On the base of the key will be seen two terminals. The wire from the firing battery comes to the one on the right hand, and the current passes up the pillar *X* and onward thru the lever (being insulated from the other circuit completely).

The wire from the cartridge comes to the terminal on the left-hand side, which is connected with the little stud *i* next to it.

It will be seen that while the key is at rest, in the position shown by the full black lines, the shutter circuit is closed. When the lever is depresesd into the position shown by the dotted lines, no current passes on either circuit; but when the key is pressed to the bottom the stud *A* comes into contact with the stud *i*, and the firing circuit is closed.

All the connections being made, and everything ready for firing, the action is as follows: While the key is untouched, current flows thru the shutter circuit and thru the shutter magnet, holding the anchor pallet back. The lower pallet engages the bottom peg on the shutter, and the lens is kept closed.

As soon as the firing key is depressed, contact is broken in this circuit between *d* and *e;* the electromagnet loses its attractive power; the pallet is pushed away by the spring; the lower pallet releases the bottom peg on the shutter; the shutter drops until its upper peg is stopped by the upper pallet. The hole in the shutter is then opposite the lens, and the plate is exposed and continues exposed all the time that the firing key is held down.

The firing key, being further depressed, completes the firing circuit by touching the contact *i*, and the charge is fired.

The sensitive plate in the camera then registers the movements of the lamps on the gun until such time as the key is released. When that happens, contact is once more made at *d e*, in the magnet circuit, the armature or pallet is again attracted, releasing the upper peg in the

shutter from the pallet and allowing the shutter to again cover up the lens.

If the key is held down from the beginning of the operation until the gun returns to rest, the camera will record all the movements of recoil as shown by the lamps.

It will be seen that the whole apparatus is extremely cheap, simple and reliable. There is this advantage also, that every part of it can be thoroughly tested before the experiment begins.

The operator must recollect that there is no forward motion of the muzzle; its motion is wholly backward. If the camera has a sliding front, the lens should be adjusted so that the image of the lamp nearest the muzzle comes close to the edge of the plate. There will then be ample margin for recording all the motion that takes place. As a rule, there is plenty of space for the vertical motion to be registered.

The experiment above described was the first attempt ever made to register the movement of a gun during recoil.

About seven years later Messrs. Crehore & Squier carried out some experiments in the United States with a Springfield rifle. They of course used a camera, but their apparatus and arrangements were wholly different from mine. Having the advantage of sunshine, they arranged a screen on the barrel of the rifle. The screen was pierced by numerous holes, and the sunlight was reflected thru these holes by a mirror to the lens of the camera, thus obtaining the same illuminated points that I had in electric lamps.

As certain persons have misrepresented these facts, I wish to distinctly state again that Mesrs. Crehore & Squier did not in any way take advantage of my experiments and they did not in any way copy them. Their methods and apparatus were quite original and in every respect different from mine. Moreover, their experiments were made with a shoulder rifle, whereas mine had been made with a quick-firing field gun.

At the close of 1902 a certain person represented to me that he was making experiments with an old friend of mine, Mr. R. W. S. Griffith, of the Schultze Gunpowder Company, on this very subject. I believed him (altho my suspicions ought to have been aroused by his ignorance of the technical terms used in the gun trade) and I gave him the minutest details of my methods and apparatus.

I subsequently discovered that this person had published the experiments as his own in a London weekly paper, and as the editor of that paper refuses to make any acknowledgment of the truth of the matter, I simply take advantage of this opportunity to call attention to the fact. The papers dealing with sporting matters in the United States have commented on the fraud, and there is no need to dwell on the affair any longer.

Shortly after these experiments of mine were made I invented a new kind of chronograph, the "Zamanap." This enabled one to take a number of successive photographs during the firing of a gun and the passage of the projectile, which gave one an insight into matters that were previously quite beyond the reach of investigators, and determined many points about which there had previously been much dispute.

Bill Miller's Pardon, or the Tribulations of a Roundhouse Foreman.

William J. Miller ('course the name is fictitious),
Is a man who was never at all superstitious;
But a dream which he had is direct intimation
Of his faith in the doctrine of predestination.
Now, the said Wm. Miller, please bear in your mind,
Is a bright roundhouse foreman, who, like all of his kind,
Has trials and troubles too many to state—
And with this introduction his dream I'll relate.

A spirit appeared at his bedside one night,
Decked out in a garment of pure, spotless white,
And thus addressed Bill: "To me has been given
Command from the Recording Angel in heaven
To ascertain why 'tis your name should appear
On the Great Book of Life, as the reason's not clear.
The profanity record has been kept for ages,
But nothing like yours appears on its pages;
Therefore 'tis decided, unless you can show
Just cause for defense, to send you below,
Where the fire is unquenched, and those who have never
Repented are roasted for ever and ever."

On hearing the latter, Bill tried hard to smile,
And invited the spirit to tarry a while.
"If I fail to make my defense in full measure,"
He said, "I'll be sentenced with greatest of pleasure.
Please remain here to-morrow, accompany me,
And report to headquarters whatever you see."

The spirit agreed, I am happy to say,
And took note of what happened the following day.
First, a conceited young clerk, with expression satanic,
Brought a bundle of letters from the master mechanic.
And here a few extracts I'll give as example
Of the bunch that the spirit took away for a sample:

"Please note that the superintendent complains
You are using poor coal for our passenger trains."
"Please let me know what excuse you can make
Why so many new compound packing rings break."
"Engine failures, last year, for the month were but seven;
I regret for the same time this year there's eleven."
"You must take up the matter and ascertain why
We used so much oil in the month of July.
You are surely aware that a half pint to use
Of valve oil per hundred is simply abuse;
I believe 'twould be wise (at least we can try it)
To give engineers feathers with which to apply it."
"The president's special is leaving to-day
At 10.25; there must be no delay."

But, alas! for the plans of mice and of men!
The telephone rang at a quarter of ten,
And the voice of the callboy announced with a drawl:
"De fireman is sick. Who else will I call?"
A fire-up man appeared just then at the door:
"The crown-sheet is down in the 74."
Then next comes an engineer, swelled like a toad—
You'd think from his looks that he'd surely explode—
And asked loud in the name of the evil one:
"Why hain't the work on *my* engine been done?"
Bill Miller, he then made an angry retort;
While the spirit examined the work report
Of this same engineer; and this was the news:
"Wash out the biler and boar out the flews.
The seems are a squirtin'. Cork all the leaks.
The rite back driver box is so dry that it squeeks.
Steam pipes are leaking. Pack throttle well.
Right mane pin cut and runs hotter than —— (it should).
All the rod bushings are lose on both sides.
Set up the wedges and line up the gides.
The air pump jerks on the upward stroak.
Exzamin' and see if the valve ain't broak.
Take down left mane rod, reduce the brass,
And don't fail to put in a watter glass.
Raze the frunt end an inch or more,
And fix the ketch on the firebox door.
I think, from the way she burns her fire,
Her petticoat should be a little hire."

Before the good spirit got through taking notes
From the book containing the work reports,
From the chief dispatcher came a message which read:
"The Golden Gate Special's engine is dead.
Send another at once to take the train.
Why you sent this one on 21 please explain."
Then the hostler announced that a broken switch
Had caused him to put engine 12 in the ditch.
The spirit departed, but on that same night
Returned with a crown, and in greatest delight
Presented to Bill's most astonished vision
A text of the Recording Angel's decision,
And a list of the great hero saints all revealed,
With William J. Miller's name leading the field.

—*N. M. M., in Locomotive Firemen's Magazine.*

A French expert has been studying the models of typical warships as determining the power required for propulsion at given speeds. He finds that the French battleships of the "Patrie" class require for a speed of 18 knots 1.18 horse-power per ton displacement, where British vessels of the "London" class required but 1 horse-power per ton for the same speed. In the new ships for Russia it is 1.23, and in the German ships of the "Braunschweig" type 1.21.

At the power-house of the underground system of rapid transit in New York there are sixty boilers of 600 horse-power rated capacity each to deliver steam at 200 pounds pressure. The boilers are of the water-tube type, built by the Babcock & Wilcox Company, each having 294 4-inch tubes, 18 feet long; the tubes are arranged in 21 vertical sections, each 14 tubes high. Each boiler is provided with three steam drums.

Machine Molding—I.*

BY G. P. CAMPBELL.

FLASKS.

It is important first to decide on the proper flasks for use in connection with molding machines. The sizes should be such that the flasks will take in a general range of work without being limited to any special piece, unless such castings are made in large quantities and when the flasks would be in constant use. Then it is a saving to make the flask as near the shape of the casting as possible with a uniform thickness of sand outside the metal. This insures not only better castings, but also makes the flasks lighter and easier to handle.

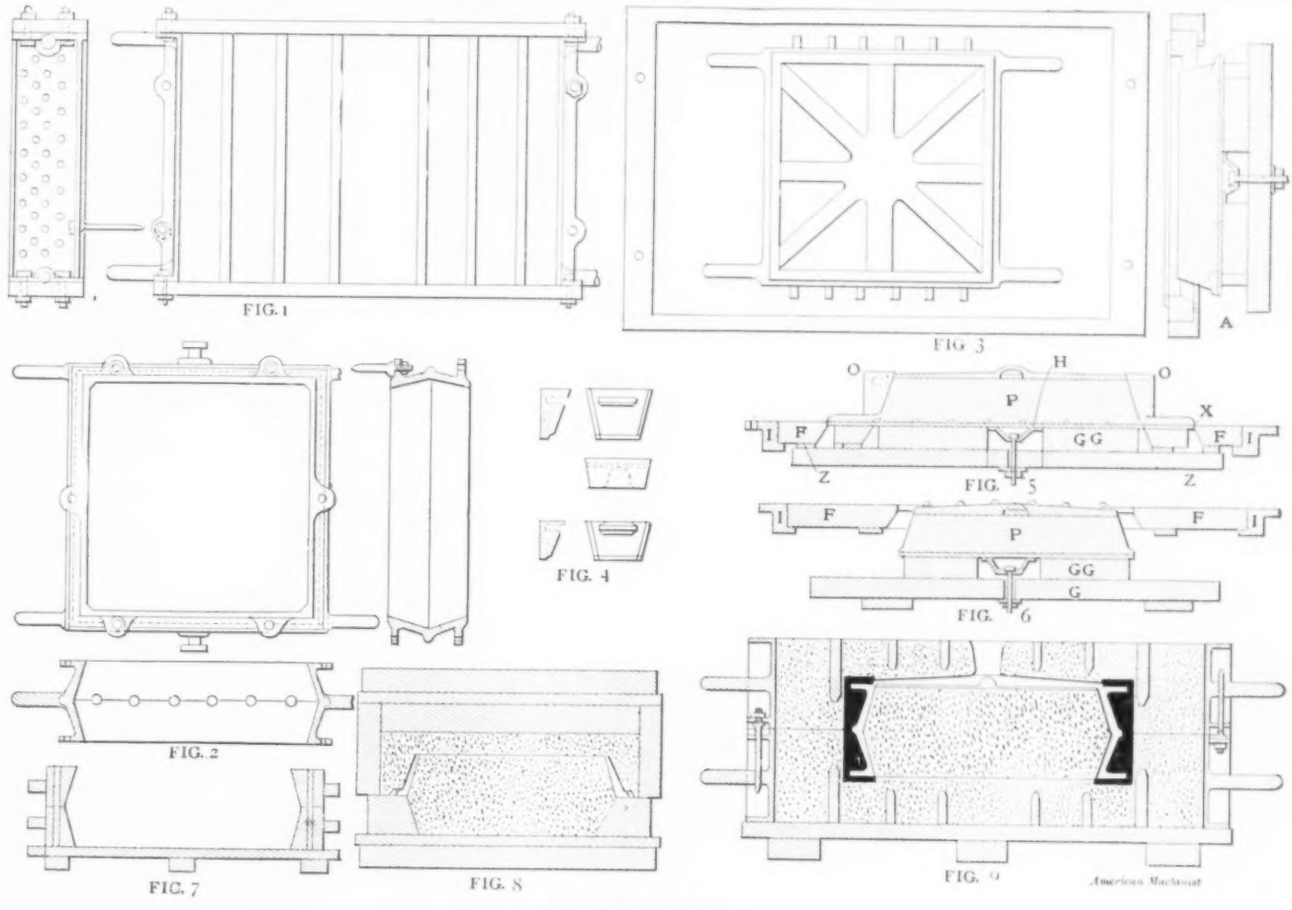
These flasks for general use should be as light as possible, yet strong enough to stand hard usage, and they should be interchangeable, with nowel and cope alike, each having two pins at opposite corners, so that it will not require a constant changing of pins to alter a cope to a nowel, or *vice versa*.

As few foundries have large storage room for idle flasks, it is often an advantage not to have too many, but rather to keep all in first-class condition by drilling out the pin-holes when they become worn and putting in steel bushings. In fact, it pays to provide such bushings at the start.

When bars are necessary they should be made light, and not more than ⅜ inch from the core or casting, so as to hold the mold firmly, make ramming easy and yet allow both sand and casting to leave the flask easily when dumped out.

A flask for machine molding is shown in Fig. 1. The ends are gray iron, 5-16 inch thick, with a rib ⅝ inch below the top extended out for the pins and pin-holes with two handles ⅞ inch diameter, 5 inches long; the four bolt holes being cored out, and the plate having a number of ⅝-inch holes to lighten it. Fifty of these castings were made in open sand; fifty pieces of 2-inch hemlock were cut to the required length, the edges straightened on a circular saw and ripped to a uniform width, and the four ½-inch bolt holes changing drills, and leaves less chance for errors.

In these flasks, Fig. 1, were made 500 of the flasks shown in Fig. 2. They were made on a molding machine by two men, all ramming and lifting being done by hand. The lugs at the ends of the flask are used to bolt two or more parts together when deeper flasks are required, and also to clamp the nowel and cope together when pouring off. The holes in the sides are for inserting ½-inch or ¾-inch round iron rods to take the place of bars to support a heavy core, or to take other heavy strain. Angle plates can be bolted to the sides of the flask in these holes. This method of securing and holding cores has proven to be about the sur-



MACHINE MOLDING.

bored in each. The sides and ends were then set up on a level place and bolted together in short order by a laborer, and the six bars were nailed in. A jig corresponding with the four holes on the molding machine was put on each flask, and the four ⅝-inch pin-holes were drilled, two pins were put in the opposite corners as indicated, and the flasks were ready for use.

The flask pins were made from 13-16 inch round machinery steel, the pin and shank the same size, being .01 inch smaller than the holes in the flask, with a small collar left on as shown. This style of pin not only makes a stronger pin, but saves

est. With round cores a gray-iron plate exactly the shape of the core is best, and should rest on the core print when ramming up. Of course care must be taken to place the angle plate where no metal flows.

The flask shown in Fig. 2 is about 7 inches deep, 18 inches wide and 18 inches long inside at the top, the flare to the center being ¾ inch in the 3½ inches or half the depth. This holds the sand perfectly and in most cases will hold the mold without any chucks. The absence of bars is a decided advantage, as the ramming can be done much quicker and saves wear and tear of patterns. A small trunnion can be

*Copyright 1904.

cast or bolted on if an air hoist is to be used. The lugs at the sides for the pins and for the holes to receive the pin are kept a full half-inch below the top of the flask to clear the collar of the pin.

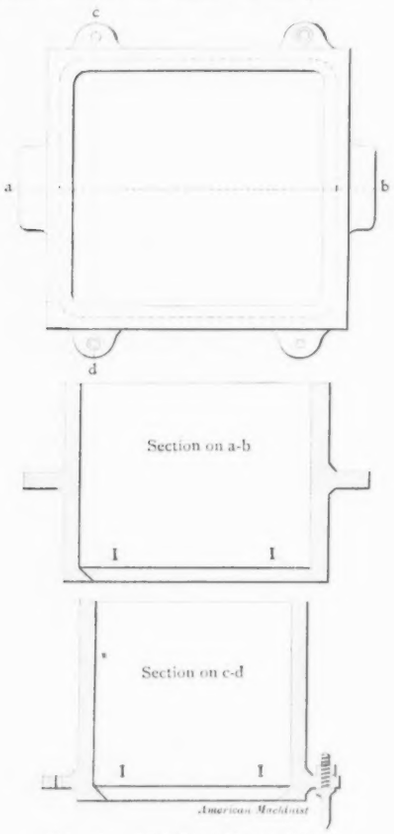


FIG. 10. THE FLASK AS MADE.

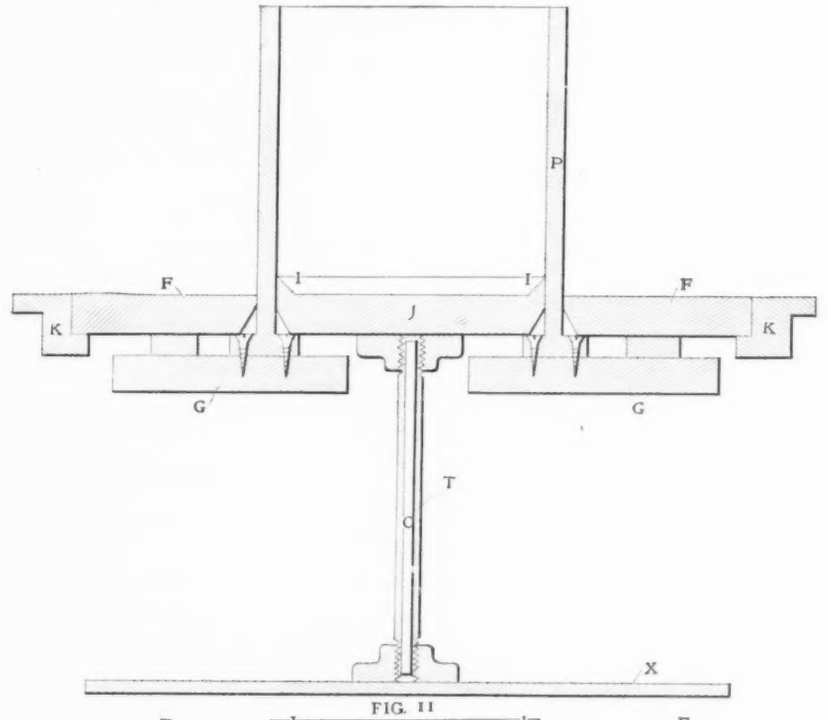
Fig. 3 shows a plan of the pattern of the flask, Fig. 2, with gates, rammers and core prints at each side. *A*, Fig. 3, shows in section the pattern withdrawn down through the stripping plate, and shows also the method of attaching the core prints to the stripping plate instead of to the pattern. The draft on the ends of all core prints should not be less than 30 degrees. *A* shows also the gates removed for making the nowel.

Fig. 4 shows the cores for the lugs. No core prints are used for these cores; the pattern is marked with red paint to locate the core and each lug core is placed against the pattern before ramming up. The pattern can also be made hollow and have the lugs drawn into it before dropping the pattern. The cores of course are cheaper, but not so good.

Fig. 5 is a section at right angles to section *A*, Fig. 3, of the machine, with the pattern up ready for ramming. *I* is the gray-iron frame of the molding machine, *P* the wooden pattern one-half only, *S* gates and runners, made loose and all fastened together; *F F*, wooden stripping plate, 1⅝ inches thick pine, halved together at the corners; *X*, ⅜-inch pieces of hardwood exactly the shape of the pattern at the joint; *G G*, the pattern plate, 1⅝ inches thick, which is attached to the ⅜-inch piece and the pattern by screws. This piece is made fully ⅜ inch less all around than the shape of the pattern. *G* is the draw plate, 1⅝-inch pine, which is bolted fast to the sliding frame by two carriage bolts, with cleats on the bottom to keep it straight. *H* is a bolt plate fastened by screws to the pattern, with a ¾-inch bolt in the middle of it; a hole is cut thru the pattern plate for *H*. *Y* and *Z* are ⅜-inch strips screwed to the stripping plate at different points in case any sand should get down there, or in case the different parts should warp or swell. A 1-inch hole is bored thru the center of the draw plate *G*. To locate the pattern on the machine the bolt is put in the hole in the draw plate, stripping plate *F* is put in the frame *I* over the pattern, which locates it centrally, and the bolt is screwed up. The stripping plate is cut away at an angle of 30 degrees from the vertical for clearance, leaving ⅜ inch straight at the top which strips the pattern.

Fig. 6 shows the pattern drawn down. Fig. 7 is the greensand core-box which forms the inside part of the flask. Fig. 8 shows the top half of the core-box removed and the nowel set on ready for turning over. The greensand core has pins and holes which correspond with holes on the molding machine. The greensand core should be rammed hard, especially at the sides. Fig. 9 shows the mold ready for pouring.

In making these flasks one man takes a greensand core-box and rams it up and at the same time the other rams up the nowel. The upper half of the core-box is taken off, as shown in Fig. 8, and the nowel is removed from the molding machine and placed on the greensand core; a bottom board is put on top, clamped securely and all turned over. The other part of the greensand core-box is removed, the cope is rammed up, the small cores for the bolt holes at the sides are put in cope, gates and runners are put on, the mold is placed in position and is ready to pour, long pins giving clearance so that it does not touch the mold at any point, 1-32 inch



THE TWO POSITIONS IN THE MOLDING OPERATION.

being allowed in the cope or in top part of greensand core, so as not to crush in closing the mold. Fig. 9 shows the mold closed ready for pouring.

The gray-iron ends of the flasks were afterward used for many odd pieces; in one instance a scale lever, 18 feet long, being made on a molding machine which had open ends, new sides being put on the gray-iron ends. When ramming up, a vent wire is placed on each core, and before the top is struck off they are pulled out, no other venting being required. This saves all stabbing at a core print or pattern, and insures a good vent. By using gray-iron strips in the foundry floor no bottom boards are needed.

The flask shown in Fig. 10 is made to take the place of snap flasks and slip-overs. This flask is made ¼ inch thick, perfectly straight inside and out, except at the lower corner. This projecting edge is ¼ inch wide, running down to the sides at an angle of 45 degrees. This little ledge is a great thing to hold the sand when turning a mold over or placing a cope in position, yet when inverted the opposite way the entire contents very quickly slide out. The great advantage in the use of these flasks is very apparent to the foundryman who handles much light work. The lugs and handles are made a good 5-16 inch thick; ⅜-inch pins are used. Figs. 11 and 12 show the pattern for this flask on the molding machine in the two positions. *P* is the pattern; *F* is the stripping plate of wood 1⅝ inches thick; *G* is the draw- and pattern-plate combined. *J* is the stool stripping plate, with pieces *I* which form the beveling projecting edge attached. *T* is a connecting pipe screwed into flanges attached at the top to the stool and to the foundation plate at the bottom. The top flange is fastened to the stool with wood screws. The hole in the middle of the pipe is to turn it to adjust the stool piece level with the stripping plate *F*.

K K is the iron frame of the molding machine. *X* is the foundation plate to which the stool is bolted with two machine bolts. The lugs or ears for the pins and the holes for the pins to enter, as well as the handles at the ends, are formed by cores which are placed where they belong against the pattern and all rammed up together. A vent wire is placed in each one, as explained before; the top is struck off, the lever of the machine is reversed, withdrawing the pattern through the stripping plate or frame, the raised edge *I* stripping inside. The gates and runners are attached to the stool, all well rounded, with lots of draft, making the entire mold in the nowel. A false cope is now rammed up with gate pin in, the gate pin is withdrawn, all corners rounded off and the cope put on, completing the mold ready for pouring, as shown in Fig. 13. *Z Z* are strips of iron sunk in the foundry floor. No bars, no chucks, no bottom boards are used.

In making the pattern for the flask shown in Fig. 10, it is better to make it just as deep as the deepest you are liable to need it, say 12 inches. Then if you want a 12-inch flask, run up the pattern to the full hight. If only a 5-inch flask is required, run your pattern up 5 inches, set the check-nut on the lever and ram up as usual. In this way one pattern takes the place of a number, as most molding machines have a check-nut to regulate the hight of throw both in raising and lowering.

Of course these flasks are light. They are intended to be so, as they are more easily and quickly handled. They should not be allowed to be thrown on the foundry floor, but piled up convenient to the machine on the molder's bench. The night men in a foundry are those who appreciate such improvements. The flasks are not only light and easy to handle, but everything drops from them without a blow from a big wooden mallet or a 16-pound sledge.

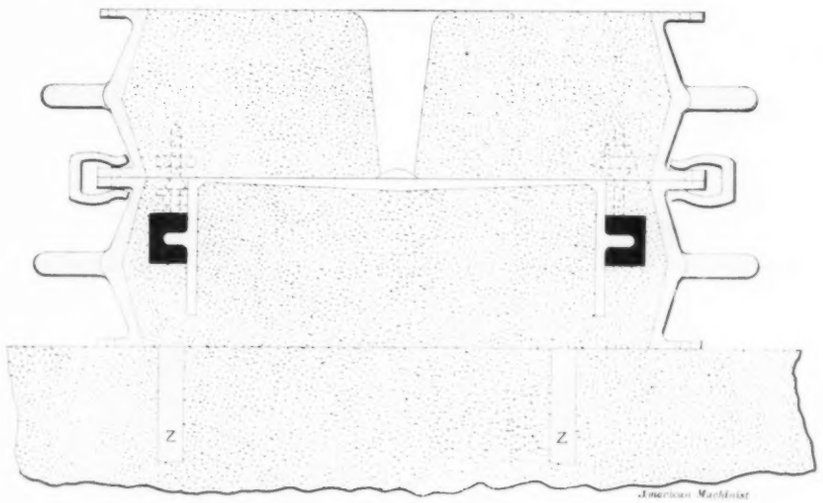


FIG. 13. READY TO POUR.

Possibility of Mechanical Flight.

A correspondent of the Philadelphia *Ledger* thus narrates his experience as an argument for the possibility of mechanical flight:

A few years ago, in a city where I then lived, there were large numbers of electric fans sold. It occurred to me that a novelty in that line would be in demand, if attractive, and using for model one of the brilliant-hued insects that everyone in the country has observed and admired for its fanciful flights and curious movements, and using an electric motor for power, the whole to be suspended on a track and used as a trolley, placed where desired, I succeeded in having a good model of my choice moving along a track in a life-like manner. I soon discovered that the best wings for easy movements made the least disturbance of the air, but did not create the circulation desired. I made several changes without the desired results, and after finishing a new set of wings somewhat different from the others, prepared to make a new trial. In making these changes I placed the model on a sort of tripod, placed near the front of the room (a vacant storeroom about 100 feet long), using insulated wire to connect the motor from a switch placed near the back end of the room. Well, everything being ready for the trial, the new wings in place, the current was turned on, before placing the model on the track, to see if all was right. What occurred? The thing suddenly appeared alive, and, without giving us time to think, was off like an arrow and struck the wall 100 feet away and several feet higher than it was when it started. One result was the utter demolishing of all its parts. Not having had in view any attempt to experiment along the line of mechanical flight, I made no special effort to make any reduction in weight. Accidents and unsought results have made many discoveries. Without offering any fine-spun theories how to accomplish results, my experiences have thoroughly convinced me that mechanical flight is quite possible without balloon attachments.

In the development of a new industry in any country it has ever been and ever will be found necessary to secure for certain responsible work in connection therewith experts in the industry. In such cases it is always necessary to secure the services of aliens. Great Britain owes in large measure her industrial greatness to the farsighted policy which brought into that country in former centuries the most highly trained mechanics that could be secured in continental Europe. So, when the *Toronto Globe* lends itself, as it did on Wednesday, to editorial support to an agitation to have the Sault works rid of American mechanics, it is taking a stand that is detrimental to the best interests of Canadian labor as well as Canadian capital.—*Hardware and Metal.* [Canada].

Letters From Practical Men.

A Proposed Graduation for Micrometer Calipers.

Editor American Machinist:

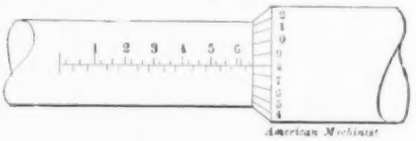
The question of changing the graduation on the micrometer in order to facilitate rapid reading with the least mental effort appeals to all who have had occasion to use one at infrequent intervals. On the other hand, I believe it to be the experience of most toolmakers and other constant users that they do not have any more difficulty in sighting odd thousandths than in adding two and two together.

The first micrometer that I ever saw or used was graduated to read twenty thousandths for one complete turn of the thimble and in this respect corresponded with that suggested by Mr. Moss at page 689. The micrometer used at present produces a change of twenty-five-thousandths for one complete turn of the thimble and is considered a marked improvement over the old design. The present design has well held its own notwithstanding the fact that a person not in practise is burdened with mental addition and runs the risk of making a mistake which might prove expensive.

The improvements in the new micrometer produced apparently quicker sighting, which was due to increased space between the indents on the stem as the result of using four spaces in the new in place of five used in the old design, and also to a more rapid travel of the screw due to increasing the pitch from one-fiftieth to one-fortieth of an inch.

Undoubtedly the perfected type of any instrument obtains when it is in its simplest form, other things being equal. It would therefore appear that, since the graduations proposed by Mr. Moss will eliminate the burdensome addition, it is a step in the right direction providing the rapid advance of the screw is of slight importance.

I suggest a modification in the scheme of graduating the stem and thimble as proposed by Mr. Moss. First, place the graduating indents alternately on opposite sides of the center line of the stem instead of all on one side; secondly, make the lengths of the indents much shorter—the shortest lines being perhaps just a nick; and thirdly, on a circle to one side of the



PROPOSED MICROMETER GRADUATIONS.

circle on which are placed the numbers of the first ten divisions mark the numbers of the divisions of the thimble which are added to the odd hundredths. This arrangement will conduce to more rapid sighting and will also overcome the objection offered by J. T. Slocomb Company at page 765. The modifications proposed are shown in the accompanying sketch.

C. E. COOLIDGE.

Keying Hubs on Shafts.

Editor American Machinist:

To answer Mr. Mather's inquiry, at page 827, about the two-key system of keying on hubs, I beg to say that when I first saw this method it struck me as a

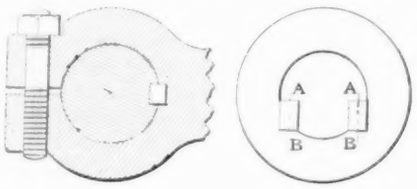


FIG. 1 FIG. 2

KEYING HUBS ON SHAFTS.

good thing. When such things are put together with the probability of their remaining together, the fit should be so tight that the work is done by the fit and a feather only necessary to properly locate the parts. But where wheels, pulleys or rocker arms are put on with the likelihood of occasional or frequent removal, then some sort of key or set-screw is necessary. If the fit is a fair one and the strain light and always in one direction, then a set-screw will do; but if a fair fit and the strain excessive and in one direction, a tapering key or a feather with a set-screw on top will do. If the strain is alternate, as in the case of rocker arms, and there is no chance to use the grip fit, as in Fig. 1, then the feather or ordinary key is not comparable to the plan under discussion, for the reason that with the feather or ordinary key there is nothing but the mechanical fit of the key sideways to take the strain, and then the metal bruises away and the things hammer loose.

In the new design, Fig. 2, if the taper on the keys is in the right direction—that is, in the direction A and B on each—the wedges of the keys are in that direction that they not only bind the boss to the shaft, but take up the wear should any take place, which is not likely, as the very operation of driving the keys beds them securely.

JOHN E. SWEET.

Squaring Numbers.

Editor American Machinist:

Anent squaring numbers, by Francis W. Shaw, at page 825, a very simple rule covers the case and the rule shows that the number does not need to end in 5. The rule is as follows:

The square of a number equals the product of the number plus any amount by the number minus the same amount plus the square of the number added and subtracted. Expressed algebraically, a being the number to be squared and b the number added and subtracted:

$$(a + b)\ (a - b) + b^2 = a^2$$

for $(a + b)\ (a - b) = a^2 - b^2$

and, adding b^2, $a^2 - b^2 + b^2 = a^2$.

Taking, first, Mr. Shaw's example, originally Mr. Bornholt's, for 65^2, he says seven sixes equal forty-two and annexes twenty-five. Altho he does not really carry it all out in his mind, the process is $65 + 5 = 70$; $65 - 5 = 60$; $60 \times 70 = 4{,}200$; $4{,}200 + 25 = 4{,}225$, 25 being the square of 5, the number added and subtracted.

For another example, find the square of 27. 30 is an easy number to multiply by, and hence we will add and subtract 3.

$$27 + 3 = 30$$
$$27 - 3 = 24$$
$$30 \times 24 = 720$$
$$720 + 3^2 = 729 = 27^2.$$

Again find the square of 83:

$$83 - 3 = 80$$
$$83 + 3 = 86$$
$$80 \times 86 = 6{,}880$$
$$6{,}880 + 3^2 = 6{,}889 = 83^2.$$

Again find the square of 74:

$$74 - 4 = 70$$
$$74 + 4 = 78$$
$$70 \times 78 = 5{,}460$$
$$5{,}460 + 16 = 5{,}476 = 74^2.$$

Mr. Shaw's remarks regarding decimals and the use of a pencil as an aid to mental calculation apply here as do his closing remarks.

H. L. W.

Squaring and Multiplying Numbers.

Editor American Machinist:

In connection with articles at pages 529 and 628 on "The Square of the Sum," I wish to call your attention to the following methods of squaring numbers not ending in 5, and of multiplying dissimilar numbers which end in 5:

Number.	Square.	Difference.
1	1	
		3
2	4	
		5
3	9	
		7
4	16	
		9
5	25	
		11
6	36	

TABLE 1. SQUARES AND DIFFERENCES OF SUCCESSIVE NUMBERS.

In Table 1 we note that the difference between consecutive squares is equal to the product of the lesser of the two numbers multiplied by 2, plus 1, or the product of the higher by 2 minus 1. Thus the difference between the squares of 4 and 5 is 9, which is $2 \times 4 + 1$, or $2 \times 5 - 1$.

This, with the methods given in the above-mentioned articles, enables us to readily square any two numbers whose units are one above or below either zero or five. For example, to square 36: We see at a glance that the square of 35 is 1225 ($4 \times 3 = 12$ and affix 25, giving 1225). Then $2 \times 35 + 1 = 71$, which added to 1225 gives $1296 = 36^2$. Or, to square 34 (whose unit is one less than 5) we say $2 \times 35 - 1 = 69$, which subtracted from $1225 = 1156$. Or, to square 31:

$30^2 = 900$, and $2 \times 30 + 1 = 61$, which added gives 961. This method then covers numbers ending in 9, 1, 4 and 6.

In the case of numbers ending in 2, 3, 7 and 8 the operation is not as easily carried thru mentally, but is easy enough to warrant learning by anyone having much such work to do. Since these are all two units greater or less than numbers ending in zero or five, we arrange Table 2 and notice that the difference between the squares of numbers arranged consecutively but skipping one is equal to four times the intermediate number.

Number.	Square.	Difference.
1	1	
		8
3	9	
		16
5	25	
		24
7	49	
		32
9	81	
2	4	
		12
4	16	
		20
6	36	
		28
8	64	

TABLE 2. SQUARES AND DIFFERENCES OF NUMBERS DIFFERING BY 2.

Thus, the difference between the squares of 7 and 9 is 32, which is four times the intermediate number 8. Then to get the square of, say, 42, we square 40, giving 1600 and to this add the product of $4 \times 41 = 164$, giving the result 1764. Or, to square 43 we square 45, giving 2025, and subtract the product of the intermediate number 44 by 4 = 176, giving the result 1849.

In any of these operations if the number to be squared is just above the number taken as a base, add the result of the secondary operation; if below, subtract.

To find the product of two numbers ending in five but whose tens are the one higher than the other, as 75×85, multiply the lesser ten by the higher + 1, and affix 75. Thus $9 \times 7 = 63$, and affixing 75 we have 6375. Again, for 35×45, we say $3 \times 5 = 15$ and affixing 75 we have 1575. For two numbers whose tens differ by two, as 25×45, the process is similar, but affix the necessary zeros and *add* 125. Stated differently, subtract the fives, multiply the lower number (with its zero) by the higher plus 10 and add 125. Thus $20 \times 50 = 1000$, and adding 125 we have $1125 = 25 \times 45$. Or, for 75×95, we have $70 \times 100 = 7000$, and adding 125 we have 7125.

If the tens differ by three, add 175. If they differ by four, increase the 175 by 50 (which we have been doing in this case); that is, add 225. Similarly if they differ by 5, 6, etc. In other words, add the result of 25 times the difference in the tens, plus 50.

A. ST. J. W.

A Transportable Drafting Table for the Home.

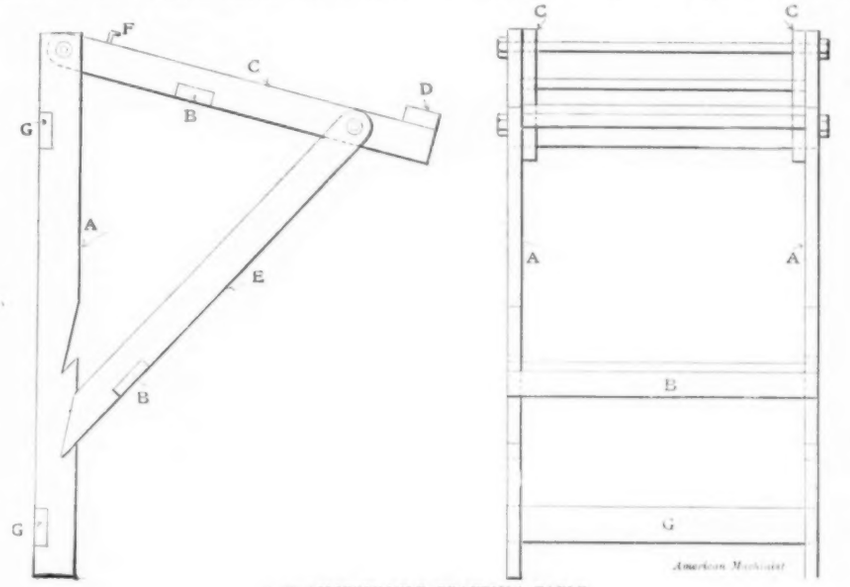
Editor American Machinist:

As a draftsman I have often had work to do at home during my spare time, and was in need of a drawing table which I could place out of the way when not in use and whenever I moved to be able to place it in my trunk. I have constructed one as per sketch and feel sure that it will be of interest to at least some other readers of the AMERICAN MACHINIST who are not blessed with a home where there is plenty of room for a more elaborate table.

I made it out of ¾-inch strips of white pine. *A A* are the uprights held in place by the pieces *G G* which are screwed to the wall. *C C* are the pieces upon which the drawing-board is fixed and are hinged to the uprights *A A* with bolts. *D* is a strip fastened to *C C* and keeps the board from slipping off. *E E* are braces which are hinged to *C C* by bolts. The ends of *E E* are cut slanting, so as to secure the board at the required angle, and come in contact with the notches in the uprights. *F F* are clamps which hold the board in position when it is dropped to the vertical position and is out of use. The pieces marked *B* are separators which keep the table rigid. I have been using this table for some time now and it has been very satisfactory.

OTTO G. REMDE.

Cleveland, Ohio.



A TRANSPORTABLE DRAFTING TABLE.

A Machinist's System for Securing Business.

Editor American Machinist:

While the shop was small and work was wanted, it sufficed for the owner to shed his overalls for street clothes and visit a few places where work enough was usually to be had to keep the machines busy for a month or more.

Now that the shop is larger and employs several hundred mechanics one man could not keep the wheels moving without a more formal system of securing work and following up inquiries from prospective customers.

Our business is the making of metal goods of all descriptions, from a small sample of a belt buckle for an inventor to the equipment of a factory complete to manufacture tin cans by the millions.

Cards are used to good advantage as an aid in obtaining orders.

Each inquiry from a prospective customer receives a number, and a card 3x5 is made out also bearing the same number.

On this card are entered the name of the writer, goods required, and quotation made, all very briefly. These cards are filed in numerical order, while the letter is filed alphabetically.

All inquiries have a card made out, whether received by telephone, personal visit from or to the customer, the source from which the inquiry originated being stated, and dates showing when letters, samples, or catalogs were sent.

The inquiry cards are kept at the writer's elbow, ready for immediate reference, the "live" cards having a metal removable clip attached, more important ones having two, while others may have a clip marked "January," showing when the subject should be taken up again.

A second card cabinet is arranged alphabetically by firm name, each card showing names of purchasing agents, what goods they buy, prices quoted and prices at which goods can be sold them and general information that may be of value. These cards are extracted when a personal call is to be made or a letter written.

Other card cabinets contain names of possible customers throughout the country, classified in groups of trades, subdivided into States. These cards also show at a glance what samples or catalogs were sent and when.

Many circulars are sent out to inventors, to advertisers in magazines and others, no record being kept of the name until an inquiry results.

When an order comes in, it is entered on a 5x8 card, filed in numerical order,

and eventually it will show cost of labor and material and the resulting profit or loss.

EMMONS COLLINS.

Boring Bar for Long Castings.

Editor American Machinist:

The boring bar in the sketch is not offered your readers as new—they would give me the laugh—but as something good in the boring-bar line for long cored holes. The person to first make and use this boring bar, I think, was Mr. John Sweet, foreman of the toolroom of the Niles Tool Works, Hamilton, Ohio; not knowing anything to the contrary, I will give him the credit. I used it in the above shops many years ago.

A is a gray-iron casting made to fit the lathe spindle and having an opening at the outer end to receive (in this instance) the turned end of a brass composition casting, an artesian well pump barrel. The work is held by compressing the chuck with the clamping bolt, as shown—the chuck of course having been sawed open at this side. *B* is the pump barrel to be bored. These varied in length, being sometimes 4 feet and at other times 6 feet long. *C* is the revolving guide bushing (gray iron). *C C* is the boring bar proper. *D* is the boring-bar holder, much similar to those seen in the AMERICAN MACHINIST in the past, and takes the place of the tool-post in the cross-slide of the lathe carriage.

On getting an order to bore those well barrels "Jack" took the casting as it came from the brass foundry, inserted a centered tapered plug in each end and turned 3 inches of the length on each end to the size of the opening in the clamping chuck *A*. After having thus "spotted" all the castings, chuck *A* was screwed on the lathe spindle, the steady-rest was placed in position, the pump barrel was chucked and the outer end centrally located by the tail spindle. A short bar or tool holder was first used in *D* and one end of each barrel was bored 3 inches deep and .004 inch larger than *C* or to suit the cutter. This gives *C* 1½-inch bearing in *B* before the double end cutter begins to act. A speed of 64 feet per minute and a feed of 1-32 inch per revolution allowed us to get the roughing cut thru a 6-foot barrel, including changing, in 40 minutes? After all the barrels had been rough bored, the end previously clamped by the chuck was bored about 3 inches deep to 3.992 inches to give a start for the finishing cutter and follower bush. It will be noticed we reverse the barrel after taking the roughing cut and before the finishing cut is taken; this is to better correct any imperfections of the truth of the bore, should such occur, as sometimes happens when the core is "bent."

We make *C* of ample length to insure the bore being straight—say 14 inches. When taking finishing cut, as when roughing, it is necessary to have the cutter somewhat larger than *C*, .004 inch being about right. *C* rotates upon the boring bar, a collar *F* having a blind screw countersunk into boring bar *C C* furnishing the thrust. A brass washer held to the front of *C* by flat-head screws prevents dust and chips entering between *C* and the boring bar *C C*. Of course it is necessary to have a different follower bush *C* for each sized double end cutter. The sketch shows the roughing cut being taken. Attached to *D* is a small tool (not shown) for slightly chamfering the outer end of the bore so that the reamer will start properly. We found the "grandaddy" reamer, Fig. 2, all that we desired when reaming the barrels. The reaming was done in the lathe the same as when boring; the speed being reduced but the feed being increased to 3/8 inch per revolution. The machinery steel body of the reamer was milled to receive one taper blade and also four pieces of wood *E* which were turned somewhat larger than the reamer was to cut. We found apple wood to be the most satisfactory, and each reamer after being used was removed (if necessary) and placed in the linseed oil barrel, there to remain until we wanted it.

On starting to ream the pump barrels the double end cutter was removed from boring bar *C C*. A piece of cold-rolled steel of the required length to readily go into the two keyways of reamer was held in the cutter opening of *C C* and the reamer was pushed on over it. The reamer was made of such a length as to allow a washer to bind it to the shoulder of the bar by the set-screw shown in the end of *C C*, or, by not using the washer, the reamer was left at the inner end of the pump barrel after the reaming process was completed to be taken out when the pump barrel was removed from the lathe. This insured a good job without leaving any marks caused by withdrawing the reamer. *A* was made amply long to allow the blade of the reamer to leave the inner end of the pump barrel and it also had two large holes drilled at opposite sides to allow chips to escape and also to insert bar for unscrewing it from the lathe spindle.

I have known it to take 60 hours' time boring a 4″x6′ barrel by the old method, while with the boring bar and reamer here shown I have known of six of the same barrels being bored and reamed in ten hours.

FIG. 2

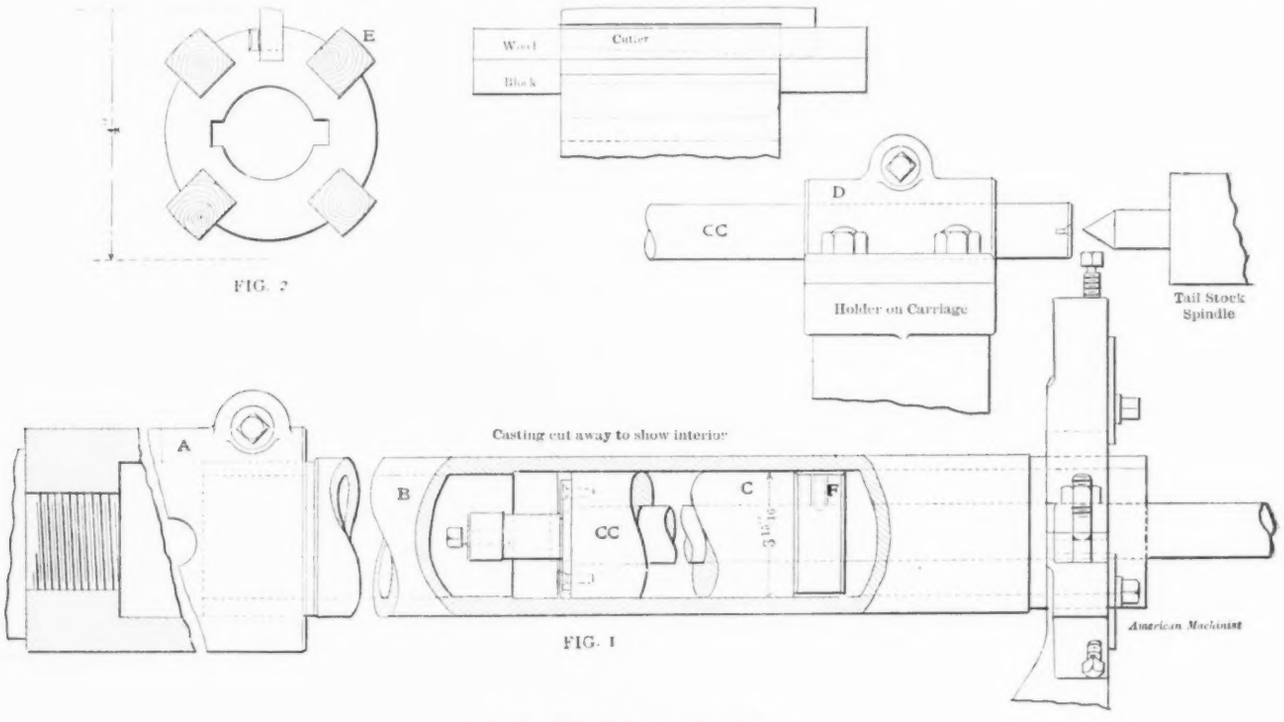


FIG. 1

BORING BAR FOR LONG CASTINGS.

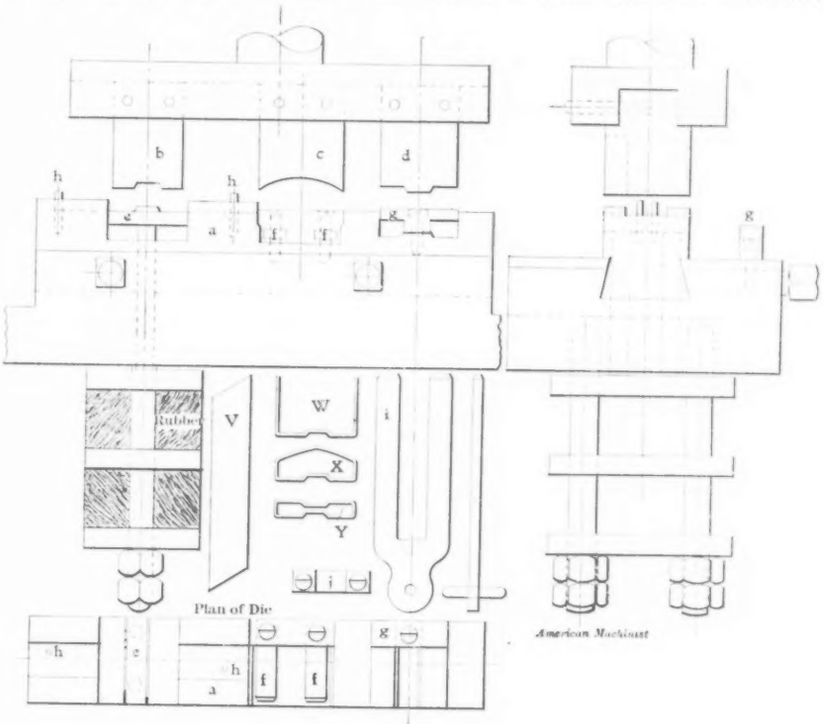
After all the pump barrels had been reamed, all that remained of the lathe work was to insert centered plugs (made for the purpose) into the ends of the barrels and cut the threads for the pipe couplings. BECK.

Triple Operation Bender.

Editor American Machinist:

I send you a sketch of a bender used for bending copper strap connectors. These connectors are made from copper blanks 11-16 inch wide, No. 14 B. & S. gage (0.064 (thick) and about 3¼ inch long. The ends are cut at an angle of 30 degrees, this being done to make a better joint.

V shows the strip to be bent. The first operation consists in placing the strip in *a* between the stop-pins *h*. It will be noticed that piece *c* is somewhat higher than the bottom of the slot in *a*. The blank should rest on *c*, so that punch *b* when brought down will grip it in the middle and hold it tightly in position. *W* shows the strip after the first operation.



A TRIPLE OPERATION BENDER.

The strip is next placed in the middle slot in *a*, the pieces *f f* being so placed as to give the correct space at the sides and the bottom and to allow the strip to be easily set into position for the second operation. The punch *c* is then brought down, which brings the ends sufficiently over the center to be finished by the third and final operation. The second operation was first tried without the pieces *f f* to hold the strip in position, but on account of the ends being cut at an angle, they would come out badly twisted. *X* shows the strip after the second operation.

The connector is then placed under punch *d*, the double mandrel or former *i* being placed through the connector under guide *g* and also resting on stripper *j*. The punch *d*, being brought down, presses the material over the mandrel *i*, forming and finishing the connector. The mandrel *i* is then drawn out, the connector clinging to it but easily stripped off by being drawn against stripper *j*. *Y* shows the completed connector. The three operations can be performed simultaneously. The punches and working parts are of tool steel and are hardened. WM. F. HOFFMANN.

The Accident to the "St. Louis."

Editor American Machinist:

I read in the New York *Herald* of July 18 that the smash-up of the engines in the "St. Louis" had been caused by "a nut giving way on one of the after cylinders." As an ex-marine engineer, this struck me as being a very small cause for such a disastrous effect, so I wandered down to the American Line dock to see the amount and find out the cause of the damage. The engineers on board would not open up at all, but I got hold of one of the shore gang who gave me the following story:

The arrangement of the engines, which are quadruple expansion (working pressure, 200 pounds) is as follows: The two high-pressure cylinders are immediately above the two low-pressure cylinders—that is to say, they are vertical tandem engines with the high-pressure cylinders on top. Then comes the second intermediate, and last, nearest the stern, comes the first intermediate. The steam from the boilers goes to the two high-pressure cylinders first, from them their combined exhausts lead to the first intermediate, which is the cylinder farthest aft. The first intermediate exhausts into the second intermediate, and the exhaust from it goes by a branched exhaust pipe to the two low-pressure cylinders, and from them the exhaust is to the condenser. About 12.45 P. M. on Tuesday, July 12, there were a series of terrific crashes, the sounds coming from the starboard engine-room. The engines were immediately stopped and on examination it was discovered that one of the *bottom end* bolts (*i. e.*, the bolts that hold the crank-pin brasses in place on the connecting-rod end) had broken, the enormous strain on the other bolt had bent it, and the connecting rod with the extra amount of play caused by this bolt being bent swung up against the outboard column and broke it. The high-pressure and low-pressure cylinders being in line one directly above the other, but one piston rod is used for the two, and as very little clearance is allowed between the pistons and the cylinder covers, the pistons on their upward stroke carried away both the high-pressure and low-pressure covers. It is probably a very good job that the low-pressure cylinder was smashed, as that allowed a clear passage for the steam to the condenser, so that there was very little steam in the engine-room immediately after the accident, it being sucked into the condenser. The guide shoe was also carried away and the crank-pin brasses smashed, but fortunately nobody was hurt. After removing the smashed gear, in order to use the remaining cylinders and three cranks, it was necessary to isolate the after high- and low-pressure cylinders. The piston valves were drawn out and their rings expanded, so as to make them fit tight in their chests, after which they were lowered into mid-position, and kept there by means of screw-jacks, ropes and wooden shores on the valve spindle crossheads. The connecting rod was swung back and lashed and shored to clear the crank. The crosshead was lashed to the steel beams crossing the engine-room. The eccentric straps were removed and the eccentric rods swung over clear of the engine. The total time from the occurrence of the mishap until the vessel started again at two-thirds speed was but twenty-one hours.

When one takes into consideration the magnitude of the job, the unstableness of a ship at sea with the engines stopped, and the heat of the engine-room, the time is remarkably good. The newspaper article as usual mentions the captain, but not a word about Mr. Snowden, the chief engineer, the man who planned the temporary makeshift, or the able corps of engineers under him upon whom the burden of the work fell.

I remember once while I was third engineer of a small tramp steamer, we had a cargo of Indian corn in bulk, to be discharged at Barcelona. Off Cape de Gata, on the south coast of Spain, we ran into a terrible gale which lasted for three days. With the working of the ship the grain got into the bilges and choked the "strums" or strainers for the bilge suc-

tions. For seventy-two hours the Cape de Gata light was on our port beam and for *seventy-two* hours we three engineers were on watch, two of us in the bilges with the bilge water up to our necks, keeping the pumps clear while the other engineer kept the engines going. Of course we merely kept the engines turning over fast enough to keep headway on the ship. And when we reached port the captain got the credit.

DIXIE.

The Milking Machine

Editor American Machinist:

I was much amused with Mr. Parks' account of the lady and the "milking machine" at page 701. It recalled to my memory an incident which happened in the early part of 1894—while I was connected with the Ryerson Laboratory of the University of Chicago. We had had things running in good shape for only a short time, when one day a party of ladies from the vicinity of Drexel Boulevard came to visit the laboratory.

I went around with them and took a great deal of pains to show them how the various machines were worked; three of the party seemed to be specially interested with what I showed them. Having been using one of the bench lathes for making some ornamental brass work, I had made each of the ladies a small oil can, with which they were very much pleased. On leaving they each thanked me very politely for my kindness, but as I was showing them out, my three ladies to whom I thought I had given some valuable knowledge and who had shown so much interest in what they had seen, turned back and asked me what all of this machinery had to do with the *cable cars*. TSUKIJI.

Japan.

A Grinder's Troubles.

Editor American Machinist:

C. W. Henry, at page 937, wants some reader to offer an explanation for his trouble with Corliss valves grinding .001 inch smaller at the center than at the ends. The explanation is simple. *His machine is not straight*, viz., the traversing table does not move in a perfectly straight line. There are but two remedies, viz., either make his machine over in this respect or have another that does grind straight. If the error was the other way, viz., large at center, and the work would admit of a steady-rest at the center, pressure on the rest would cause it to be straight; but, as it is, the machine must be made correct before correct work can be done.

What he says about grinding shafts *too large* for machine is not at all clear. Why work "too large" can be ground on steady-rests any better than if "too small" is a poser. With all modern grinding the work is ground on steady-rests whatever the size. What does he mean?

St. Louis, Mo. C. H. NORTON.

[As to this last-mentioned point, we should judge that Mr. Henry meant too long for the machine; otherwise we do not see how there could be an overhanging end of the shaft supported in rests.—Ed.]

Inside Gage and Depth Gage.

Editor American Machinist:

The enclosed sketches show a pair of useful and inexpensive tools. Fig. 1 is an adjustable inside gage for work under 12 inches, and will be found very useful in connection with the large micrometers and graduated feed screws in use now.

The body is 3/8-inch brass tubing, of such gage that 5-16 inch drill rod just

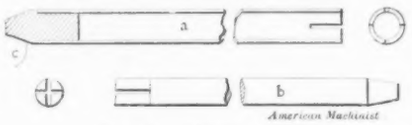


FIG. 1. INSIDE GAGE.

slides freely in the hole. *c* is a hard steel end forced in, and *b* is 5-16 inch drill rod with hard end, the back end of which is sawed through twice and slightly spread; this, with end of *a* closed together at the saw scarfs, makes a firm tension. With this gage the hole can be measured while yet on the safe side, then the micrometer will tell the size of hole and it is up to the cross-feed index then to get useful.

Fig. 2 is a small gage, with body of commercial key stock, the hole lengthwise being drilled nearly through and finished with half-round square-end reamer. The piece carrying knurled nut is fitted freely to this hole and clamped firmly back

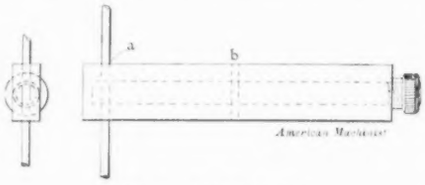


FIG. 2. DEPTH GAGE.

to drill the cross holes for a small size drill rod at *a* and *b*. The tension is adjusted for a sliding fit or locked firmly by the knurled nut. Wire may be used in either hole and changed instantly, and can be used in the end for reaching around where the ordinary gage is useless.

W. H. SAWTELL.

Queer Behavior of Celluloid Triangles, Etc.

Editor American Machinist:

Perhaps some of your readers belonging to the "drafting fraternity" have been troubled more or less by the "sweating" of transparent celluloid triangles. A case of drawing instruments has recently been badly damaged for me by this "freak." Several triangles were left lying on top of some instruments in a tray for over a month. The room was dry, the instruments enclosed in a desk drawer. When they were again wanted their steel parts were found so badly rusted that they had to be thoroughly cleaned and polished before being used. But those in the same tray not immediately beneath the triangles were hardly affected except in a very few spots.

A fine section liner having a bronze base, nickel-plated steel rod and a celluloid blade was also ruined, altho in a tight case by itself, the blade being turned back over the metallic parts. The nickel plate had been loosened in several spots which had rusted; the steel rod, being very close to the blade, was deeply pitted with rust, while the bronze base was covered with a blood-red oxide (?) on the upper side, which held to the metal most tenaciously. The atmosphere was not particularly damp at any time, but small drops of moisture would stand out on the metallic parts directly beneath the blade, the latter being perfectly dry. Even when these parts were wiped dry and the instrument replaced in the case these drops would again appear in two or three days. These phenomena were not new, having been noticed on several occasions since the instruments were purchased.

The following expedient was then tried and adopted, which has, so far at least, prevented a recurrence of the trouble, but has been on trial for only about five weeks. Appearances would indicate that it will effect a permanent cure.

Two sheets of blotting paper were cut the size of the tray and two the size of the section liner box. These were then bound on three sides with manila paper so as to form a flat bag. Inside this bag was placed powdered, unslacked lime, forming a layer about 1-16 inch thick and the open end sealed, the sealing preventing the loose powder scattering about the trays. The instruments were laid upon these pads and the triangles placed in their original positions. The fact that the presence of a drying agent prevents the deposition of moisture would warrant one in believing that this moisture was condensed from the atmosphere, but the difficulty is to determine what role the celluloid plays in the matter.

Another change that is taking place in some very fine, large celluloid angles is equally puzzling. These angles are about three years old, are used only occasionally and lie flat in a drawer on some manila paper, being covered with same. About a year ago white spots began to appear in two of the largest, a 14-inch 45° and a 20-inch 30°x60°. These spots seemed to have no origin, but are gradually growing white, quite noticeably on the yellow background of the celluloid. A short time ago cracks began to develop, possessing star-like outlines, in the center of the white spots, and in a month the points of these star-like fractures were radiating in every direction; two weeks later the angles literally fell to pieces, the 14-inch breaking into four pieces and the 20-inch into two pieces. That an internal strain existed in the material was evidenced by the fact that after the first break in the 14-inch angle the adjoining edges stood apart about 3-32

inch. A 24-inch straight-edge 2 inches wide is also cracking now about ¾ inch long and at a right angle to the working edge.

In another instance a button-shaped piece has chipped out of the center of a curve, leaving a cup-shaped depression about ¼ inch in diameter and 1-16 inch deep.

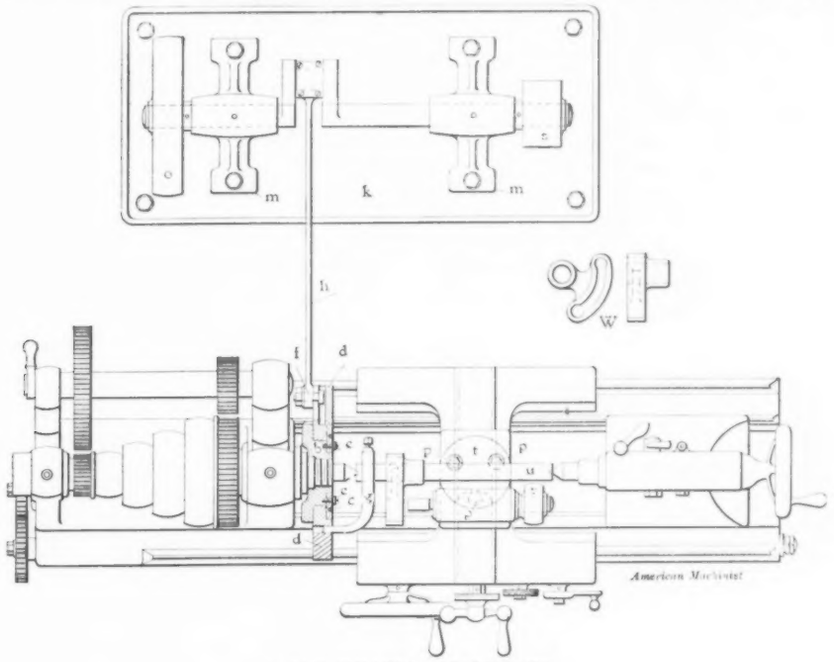
Another freak that this material has played has resulted in the ruin of a 36-inch T-square. The blade is ⅛-inch mahogany, edged on both edges with a celluloid strip about ⅜ inch wide. These strips have been contracting for some time (first noticed a year ago) and have now torn the wood of the blade for about 18 inches from the head on the working edge, and a similar distance on the opposite edge and end. The glue held but the wood is split in a strip about ⅛ inch wide. The transparent edge is fully ⅛ inch shorter than the blade and the strain exerted by the remaining attached portions has resulted in bending the blade edgewise.

It would be very interesting to hear from others that may have had similar difficulties with these "pets," and what methods, if any, they adopted to correct the faults. Triangles in constant daily use I have never known to act in the manner described. R. G. GRISWOLD.

A Cam Milling Attachment.

Editor American Machinist:

An unexpected big order came in one day for printing presses to be ready for shipment at a certain time, and without sufficient modern tools to make them rapidly. It was suggested for us to build a few attachments rather than to buy machinery, as an order of this kind probably would never come again. We at first thought the arrangement here shown rather expensive to build, but since it has been built and used we have never regretted the outlay. We formerly "jigged" the gray-iron cam *W* in the lathe by hand with a boring tool, and it is astonishing what a difference in the result there is by this trifle of expense. The cams are of different sizes in the bore and diameter, and they have to run perfectly true with the hole. We had the hangers first placed above the lathe, but found them inconvenient and in the way, and as there happened to be plenty of room behind the lathe, this proved very satisfactory, placing the hangers central or, in other words, at the same hight as the lathe spindle.



A CAM MILLING ATTACHMENT.

The assembled attachment is shown in plan. One point of advantage that will be noticed is that it was unnecessary to change the construction of the lathe in any respect. There was not even a hole drilled or any alteration made that would in any way impair the efficiency of the lathe.

The face-plate is made in three different pieces, each of machinery steel. Part *b* is bored and threaded to fit the end of the spindle, with two holes on the side to fit a spanner wrench, and it is extended back a little way over the collar to make it stronger and also to provide room for the revolving face-plate *d*. A ring *e* is internally threaded to fit *b* and screwed up to a shoulder securely with a spanner wrench. To make this more secure from getting loose while in operation, two ⅜-inch screws *e e* were inserted. The revolving ring *d* has a turning fit on the sides and the bottom, with a T-slot milled on the back to fit the screw *f*. This gives it an adjustment for different sizes of cams as required. The screw *f* has a 1¼-inch straight part turned on it to fit the eye on the end of the rod *h* with a turning fit when the nut is screwed up to the shoulder. The other end of *h* fits the 5-inch throw crank on shaft *i*.

The gray-iron plate *k* is placed on four legs and fastened with a screw in each corner. On this plate are the two hangers *m*. The bore of these hangers must be the same hight as the centers of the lathe so as to make room for the crank and the cross-belt to run. On each outer side of the hangers is placed a collar with a set-screw to keep the shaft in position, and on each end of the shaft is clamped a wood pulley. The pulley *o* is somewhat larger than the cone step.

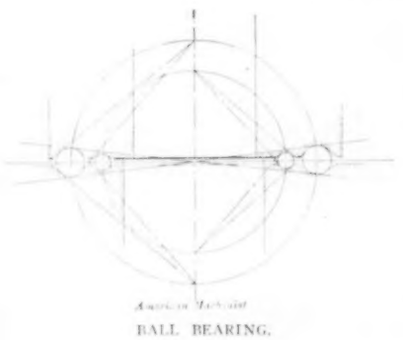
The milling attachment proper, *t*, is fastened to the cross-slide of the lathe carriage by three screws *p*, and its application in no way changes the lathe for ordinary purposes. The spindle is held in position with screwed-in rings on each end; it has a ½-inch hole thru its center for driving out the cutter. On the end is keyed a gray-iron pulley *r* smaller than the pulley *s* and narrower. This gives the cutter a uniform speed and also provides room for the belt to travel when the feed is in operation. The arbor *u* carrying the cam to be cut comes between the two parts of this belt.

After the cam has been bored it is driven on the arbor and the dog is not fastened until the arbor is on the centers and the cam is located in its right position for the cutting. The lathe is geared to its lowest feed, and when started the cam works back and forth thru the required angle and the milling cutter works its way thru the slot. A. L. MONRAD.

Ball Bearings for Thrust.

Editor American Machinist:

Allow me to add to what has been written on ball bearings at page 226. I have been using the construction mentioned for the past ten years on crane hooks and upright thrust bearings, and have sometimes found it wise to put in two rows of balls in the bearing and instead of making all the balls the same diameter (I have seen it done) I make the outside row larger, using the construction shown in the sketch. You will at once see that the wearing surface is proportional to the speed, hence the outside balls will wear equally as well as the inside ones.



BALL BEARING.

This is just a point I thought would interest you; "trifles make perfection," and we find that these little trifles all go to make or mar a machine. D. L.

England.

Making a Gasoline Engine Cylinder.

Editor American Machinist:

While a few makes of gas and gasoline engines are air-cooled, the majority of them are water- or mixture-cooled, and the cylinder here shown is no exception, altho the brass water jacket is not shown in place. As these cylinders (there are four in the engine) are 8 inches bore by 10 inches stroke, and are to have at least 90 pounds compression per square inch, thus giving an explosion pressure of 350 to 400 pounds per square inch, and with cylinder walls a trifle thinner than it is safe to have them, it will be seen that there must be no mistake in the quality of the iron used or in the manner of casting, and it was at just this point that further progress was for a time arrested.

As the shop had no foundry of its own, we were obliged to get our gray-iron castings at one near by. Now, I believe the best results are to be obtained by consulting the man in charge of the foundry before making a pattern which may be out of the ordinary; so taking the drawing I made my molder friend a call. I showed him the drawing and asked him how he wanted to mold the pattern and place the core and, after looking at it, said "Top end up." This is as shown in Fig. 1, which is a vertical cross-section on line *A B*, Fig. 4.

As I had previously made up my mind that those cylinders must be cast top end down, I promptly rebelled at his way of molding, and called his attention to the fact that the top end was to be the explosion end and that if molded top end up the dirt and blow holes would all be at the top, allowing leaks and making a weak casting, all of which he admitted; but he could not mold it top end down and place the core.

As this particular foundry has for several years been turning out gasoline cylinder castings, using a special cylinder mixture that gave ½-inch-square test bars a tensile strength of 23,000 pounds per square inch, and as the cylinder walls were to be so thin I could not afford to go elsewhere and get iron that would test as low as 13,000 pounds per square inch and where on the record only one bar out of six tested to 18,000 pounds, altho the designer had recommended this particular foundry as the best place to get cylinder castings.

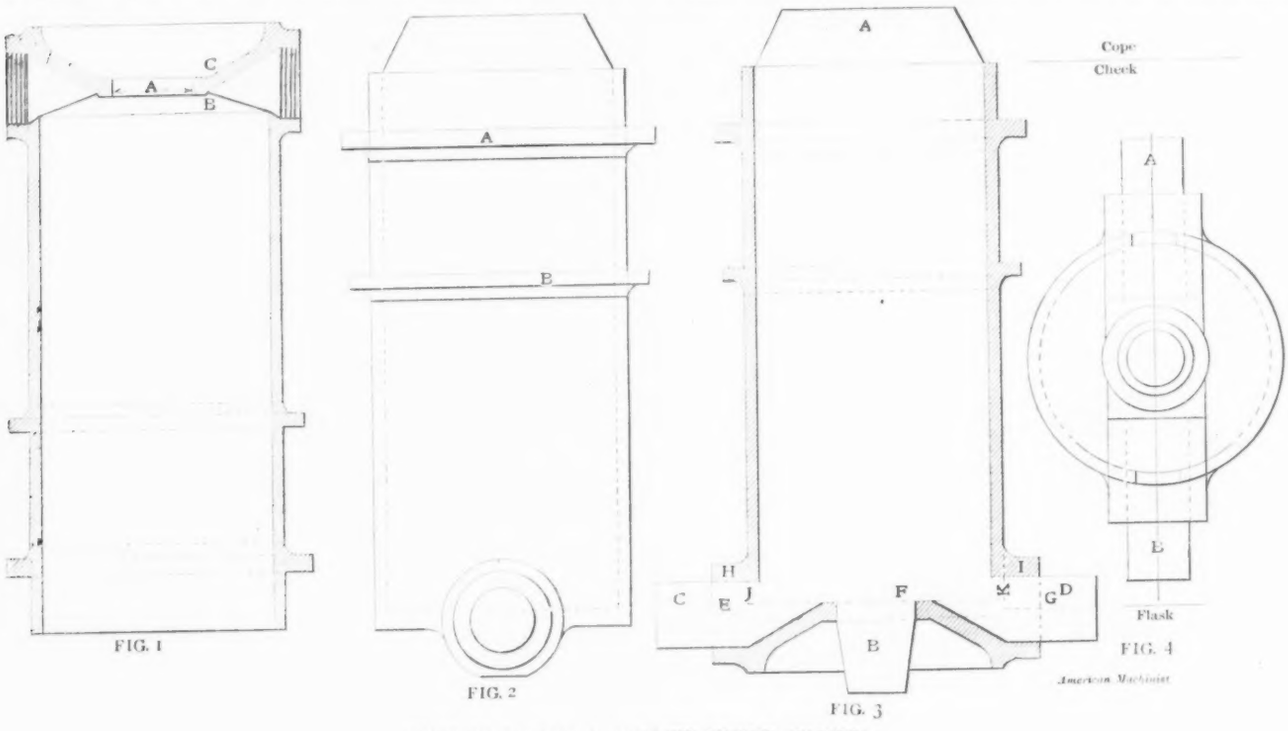
While the foundryman recognized my contention for castings strong and sound, he still demanded a pattern that could be got out of the sand, and that the core could be properly placed and held, and as I had no feeling for the pattern I offered to quarter it, slice it, make it in sections of any shape, suggested to him to roll the flask over, to use a skim gate or a horn gate, to flow a lot of iron out at the top, or put on a riser. We sparred in this way for two hours and a half, during which time I suggested the adoption of all the foundry kinks that I had ever seen or heard of, and even suggested a few new ones to be tried; but it was of no avail, his only answer was "no." He didn't seem to care whether he got the job or not.

I was nearly ready for dinner, but determined to return and renew the assault on his stronghold, when, turning the drawing upside down for the "eleventeenth" time, a different parting not only in the pattern but in the sand and also the core was suggested. At first the foundryman offered two or three objections, but finally with a couple of minor changes he acknowledged the job could be done as I wished, top end down.

Having settled the question with the foundryman and his foreman, I took the drawing to the patternmaker, and there I had some more difficulty in getting the patternmaker to catch on to the idea of the top of the cylinder and the inlet and outlet cavity and how the core-box would look, and not until I took a round piece of wood and whittled an approximate shape of the cylinder top did I really get the job started.

It is possible that the patternmaker was not after all so very slow at understanding the drawing when three draftsmen were unable to come to an agreement as to just how the cylinder casting would look.

As before stated, Fig. 1 is a vertical cross-section of the cylinder on line *A B* of Fig. 4. Fig. 3 also is a vertical cross-section on line *A B* of Fig. 4, but it also shows the core inside of the casting, and looked at in this way it is not difficult to see how the core box would look on the inside. Looking at Fig. 3 as a pattern, the core prints are represented by *A B C D*. The core print *A* is loose and is molded in the cope. Core print *B* and the bottom halves of prints *C* and *D* are all as one piece, the parting being along the lines *E F G*. All below the line *E G* is in the flask. The top half of print *C* and boss *H* are fast as one piece, but are loose on the pattern, the parting being at *J E*. The line *K G* is the parting line for the print and boss *D I*, the pattern from the line *E G* to the top of the casting being in the cheek. The rings *A* and *B*, see Fig. 2, were cut into four loose pieces and were pinned on by small brads. Fig. 2 is an elevation and shows the shape of the cylinder looking from *A* to *B*, Fig. 4.



MODE OF CASTING A GASOLINE ENGINE CYLINDER.

The pattern is rammed up in the sand as far as the top of the bottom ring, at which point the molder will dig into the sand and pull out the nails that hold the ring in place, then fill in with sand to the top of the top ring and dig down and remove the nails from the top ring and then finish ramming the cheek and cope. The cope is now lifted off and the print *A* is taken off of the pattern. Under it is a rapping plate and, as the pattern is largest at the top, it is drawn out of the cheek. The molder now reaches in and draws out of the sand the pieces of the rings. The cheek is next lifted off and the pieces *B*, *C* and *D* are drawn out of the flask. The core is then placed, the cheek and cope are put on and the whole clamped ready for the hot stuff and is then cast as it should be, top end down.

These cylinders were bored on a horizontal boring machine, being held in two heavy steady-rests, one at each end. The outboard end of the boring bar which passed through the hole in the top end of the cylinder slid thru the tailstock bearing. The cutter head was of gray iron with inserted teeth and was driven by a key and held in place by a set-screw.

After the roughing boring cut the cylinder was placed on an arbor and a roughing cut taken off the outside. The cylinder was then annealed, after which it was bored to size and the finishing cut was taken over the outside. The two surfaces *B* and *C*, Fig. 1, were faced off in the boring machine. This hole was closed by two hand-hole plates. The two port openings at the top of the cylinder were bored, faced and tapped on the drill press, being held in a special fixture to insure the proper location of the holes. The total length of this cylinder was 21 inches.

G. SCHNEIDER

The Pi Triangle.

Editor American Machinist:

The letter of M. E., at page 937, reminds me that about twelve years ago I described an identically similar triangle in *The Compass*, at page 64, November 1892, copy of which I send you under separate cover. This triangle, called "Cox Pi Triangle," was copyrighted and was then made in black rubber and sold by Keuffel & Esser Company, in two sizes, namely 7 and 10 inches, and can, I presume, still be obtained from them. It is inconceivable that a patent could be had for this device.

WM. COX.

The Simplification of Words.

Editor American Machinist:

I have read the article in the AMERICAN MACHINIST on "The Simplification of Words," with a quotation from Brander Matthews, "that there is no standard of spelling in English, and that usage has always been shifting."

One of my duties has been to write letters relating to, and descriptions of, mechanical matters, and I can heartily endorse all of your editorial at page 470. While not a special pleader for spelling reform, as laid down by organizations, it has ever been a pleasure to me to note the progress of rational spelling, however slowly progress may be made. I recall, about ten years ago, writing "gauge" without the "u," when my dictator corrected me somewhat decidedly. My duty as a subordinate, in writing for that man was, of course, to spell the word as he wished, and there may be times when we are quite powerless to use what we regard as a preferable form of word. But almost everyone has authority at some time to decide how some printed matter shall be gotten out, and then the friends of improvement can forward the movement when the "program" is being printed. When such a word as program, with its omission of two silent letters, is used, it is not so much a triumph for the word as it is a recognition on our part of Prof. Matthew's principle of opening the reform door by dropping useless letters when we see fit to so improve. Would it not be too bad, when machinery and mechanical methods are being improved thru changes, that the words used to describe the improvements should remain archaic?

Some few years ago a prominent religious paper of my own faith laid down the dictum that there was a standard of English spelling to which it had always adhered, and to which it would ever cause its compositors to strictly adhere. Doubtless the editors of that great journal were learned men, but a schoolboy knows that our language is in process of change, and has been so changing for centuries. Words are becoming obsolete, words are being created or compounded, and words are being changed in meaning and in letter structure, and in behalf of our boasted enlightenment let us hope that it is all for the better.

Instead, then, of its being a crime to aid the process of change, as my critic of "gage" thought, and as the religious paper might hold, how much better to cheerfully join in the inevitable movement, of which the AMERICAN MACHINIST is a consistent exponent. I say "consistent," for it holds to its system even in its advertising columns. One prominent engineering magazine, while it "labours" to "honour" its "favourites" in its reading columns, yet employs some very un-British spelling in its advertisements of American manufacturers. Why are there no "moulders" on this side of the water, when there are many of them abroad? Answer: Because of the "tendency to more exact phonetic expression."

The Standard Dictionary has done much to forward the idea of the AMERICAN MACHINIST editorial, and says, *e. g.* of the word draft: "*Draught* is the earlier spelling, but the tendency of the language toward shorter forms and more exact phonetic expression has led, especially in the United States, to the wise adoption of the spelling *draft*."

In evidence that the language is changing, it may be noted that the Standard Dictionary recognizes, and in most cases gives preference to: Sanhedrin for Sanhedrim, check for cheque, manila for manilla, manito for manitou; while the present-day usage in England of waggon and tyre for wagon and tire is not favored. Of special interest to mechanics is the use of gage for gauge, adz for adze, ax for axe, disk for disc; also the use of fiber and center, while chlorid, chlorin, bromin and morphin are each shorn of a final "e." In a large factory in this city, employing half a hundred draftsmen, the department is usually called the "drawing room." Well, anything to get away from "augh."

Though we have some trouble in reading him, I suppose all admit that "English" was spoken in the time of Chaucer; but, not to go back so far, I hold in my hand two books printed, respectively, in 1777 and 1779, in which these words are found: cloathed, expence, surprize, waggs, centinel, chearful, gulph, tye, compleat, vyed, etc. Our word "nowhere" was at that time two words, "no where."

Of course changes are not always improvements, and my humble opinion is that the "crouded" and "aukward" of a hundred years ago, instead of our "crowded" and "awkward," were the better forms.

A list of the present accepted English words that have been coined for modern needs would be an interesting compilation. Perhaps it is safe to say that the literature of the mechanic arts has in some case suffered severely for the lack of wise initiative in the coining of words, and so we come to have such clumsy comages or incorporations as automobile, chauffeur, motorman and typewriter. "Aluminium," when it came into extensive use, was fortunate in becoming aluminum.

DUGALD MCKILLOP.

Inquiry for Machinery.

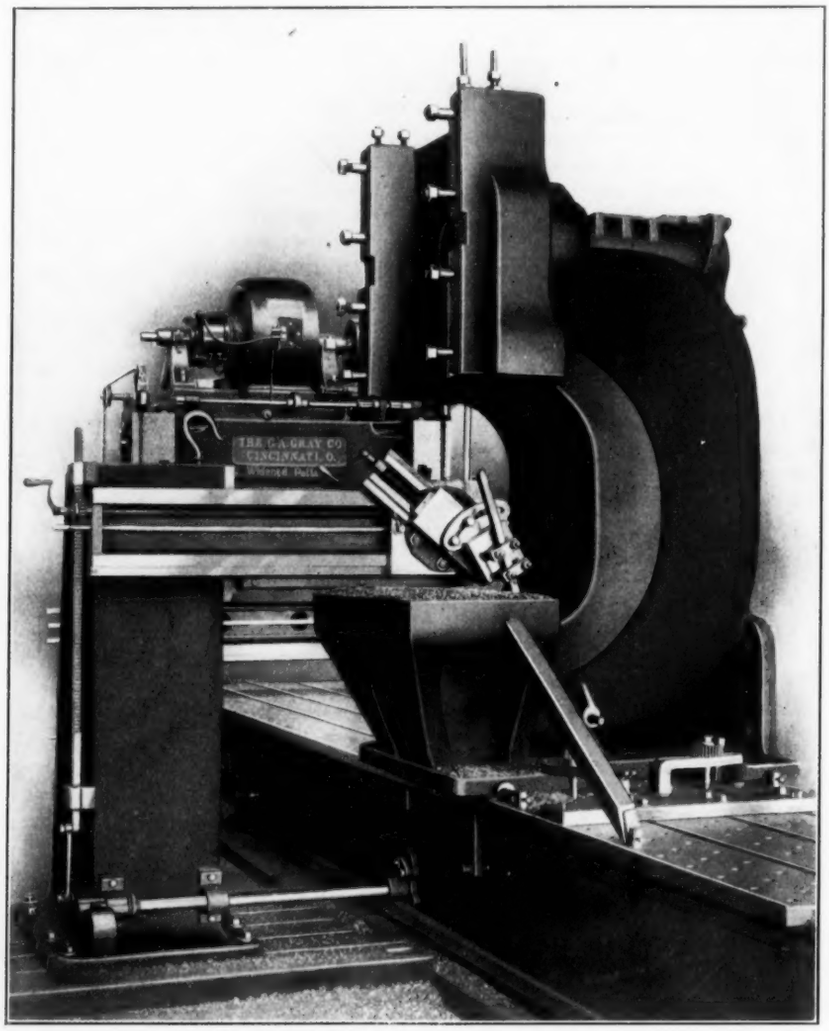
(178) We have an inquiry for names and addresses of manufacturers of machinery for making tinsel cord.

Our British contemporary, *The Engineering Times*, has discovered that there is a considerable exportation of heavy machine tools from England to the United States, and in its issue of July 7 it publishes illustrations of some of these tools which it states have been supplied to an American firm. The tools include what is known as a "snout-boring machine," a type of machine which we believe was originated by Joshua Buckton & Co., Leeds, but which is not built in America, and a cross cylinder boring machine. No statement is made as to what firm in America has purchased these tools.

Independent Planer Housing in Action.

At page 568 we illustrated and described two forms of independent housings as made to be operated in connection with the Gray planers, one of these being for vertical planing and the other for horizontal planing, both provided with automatic feeds.

We illustrate herewith one of these independent housings in action, its work in this case being the replaning of a die-seat of a large punching machine frame. This frame is 8 feet high, 5 feet wide and weighs 8 tons. This work was done upon



INDEPENDENT PLANER HOUSING IN ACTION.

a 42x42″-widened-to-54″ Gray planer, which planer is driven by the motor seen in the background, mounted on top of the housings. The illustration indicates clearly enough how a job of this charcter is done in an efficient manner, tho ordinarily it would take either a much larger planer or would be done at a very great disadvantage.

The Wellman-Seaver-Morgan Company will make at its Akron (Ohio) plant disappearing gun carriages for the government to the value of $250,000.

Echoes From the Oil Country—Opinions and the Stop Watch.

Next to having someone agree with me comes the pleasure of having someone disagree with me. Indeed I sometimes think there is more pleasure in the latter. If his taking the opposite view shows me that I am wrong, it at least gives me the opportunity of hiding my ignorance in the future; while if I think he is wrong, it gives me the chance to get back at him.

I am glad to know that Mr. Harrington Emerson has been following me more or less closely, and I am not surprised that he has found something wherein our ideas did not exactly coincide; but really, now, I do not think he has said just what he intended to in his article, "Savings with High-Speed Steel." I mean just in the beginning. Near the start-off he says, "Opinions are worthless." Right here I want to flag him, as I think he is off the track. An "opinion"—a real simon-pure article, one worth having, like you pay a lawyer good money for and then don't follow, because your "opinion" does not agree with it—is the judgment of the mind. If there isn't any mind you must not expect much of an opinion, and if a good mind is without any information on the subject, you must not look for a valuable opinion on that subject.

As I view it, opinion is the view we get in our minds of things before they have developed to the place where they are known, and it would most certainly be foolish to try to substitute opinion for knowledge where knowledge can be used instead. There is a saying that I used to hear among the "Pennsylvania Dutch," and while not as elegant as it might have been, it was quite expressive, and it ran this way: "If your foresight was as good as your 'hindsight what a smart fellow you would be!" While this saying is true enough, I never understood it to be intended as any reflection on the necessity of making the very best use possible of foresight.

I have an opinion that Mr. Emerson had an opinion about the savings, or lack of savings of high-speed steels before he went to the expense of the stop-watch, etc., and if a man has anything that is more valuable to himself than his opinions, it is not in the line of unaccomplished possibilities.

There is just another point where my friend and I seem to differ (I have never met Mr. Emerson personally yet, but I know we will be friends when we do meet) and that is in our estimate of the value of what others think. Before I got the opinion from these foremen and others, I stirred them up on the subject, so that I really believe that they did *think;* and while it may not especially interest some to know what they thought, that thinking may be valuable. I do not know that I deserve any credit for starting thought; but if disgust at the thoughts and the opinions of others gets some capable person stirred up to the point where he will investigate and then give us the benefit of his discoveries, it has served some good purpose after all. It might be as well to be sure when one is getting thoughts from others, to get them from people who are good thinkers, just the same as we select good workmen to do other kinds of things for us.

I find that observations with a stop-watch are not altogether the simple and perfect things that might be supposed. I have been doing a little work in that line myself. Not being much of a sporting man, I was not much acquainted with the actions of a stop-watch, but last winter, when in New York, in company with a mechanical friend I went into a place where such things are kept.

We each wanted one for time dissecting, as we had begun to realize that it was hard to know the accurate cutting time on any job. We found that a stop-watch would start from a pressure of the thumb and stop with the next pressure. At the third pressure it would fly back to the original starting point. It was a very good arrangement for timing racehorses,

but for most jobs in a shop it was little, if any, better than a common watch and a pencil and paper. We wanted watches that would start and stop and start again and stop, and so on indefinitely, just as the cutting started and stopped. On telling our wants, the experts of the establishment were consulted, and we were informed that there was nothing of the kind made in watches, but that the cash-register people might be able to furnish us with something that would help us out. I began to think that the people who were using stop-watches might not be getting the quintessence of perfection in their timing either, or else they knew something about using them that I did not.

Not being at all satisfied with getting the opinions of various ones, and finding out what they thought, altho that was all very well for a start, I got a stop-watch and after fussing with it for some time on the plainest kind of jobs I became disgusted with it and went to a friend who is an expert watchmaker. He told me that he had never heard of such a watch as I wanted and did not think they were made; however, he rebuilt that one and now I have a watch that will start at a touch, stop when desired, start from the stopping point, and start and stop as often as the job may require. At the finish it shows the sum of all the cutting time, no matter how often it has been started and stopped. It is only necessary to press the button when the tool starts to cutting, and to press it again when the tool stops cutting, and repeat these operations as often as the job being observed requires. When thru with the job, and ready to start with another one, a touch in the right place sets the hands to zero ready for the next job.

My first experiences with the stop-watch led me to think that where it was hard to get an accurate opinion of the time used in cutting alone it was also hard to get the real time by the use of the watch, but with the rebuilt one it was quite easy.

On one job of planing a set of small brasses on a shaper I found that out of a total time of 6½ minutes the cutting time was 2 minutes and 57 seconds. As this included working on the flanges and going over four sides and having them come to a snap gage, it can be understood that there were in the neighborhood of thirty startings and stoppings. On another little job, it was lathe work; it took 3 minutes and 10 seconds to do the piece, and of this 45 seconds was cutting time. There were eleven times of cutting, and five different tools were used.

The result of my observations has been to strengthen my faith in the opinions of a thinking man, for I have found that the estimates of time given to me by the men have been very close. Of course there were men who had never *thought* of the matter and did not have an idea on the subject that was worth calling an opinion.

My observations have been in a shop building gas engines. Most of the cutting times are short, and the amount of material to be removed is as small as can safely be allowed. I believe that our results will compare favorably with others in the same line of work.

I do not suppose the readers of the AMERICAN MACHINIST care to build or rebuild stop-watches for themselves, but if they will show that they want the improved article I do not doubt that some enterprising firm will have an advertisement inserted showing that it is ready to to supply all wants at a reasonable price.

Such a use of the stop-watch as can be readily made will clearly demonstrate the value of having things handy for the men. Another drill grinder might mean as much as an improved lathe if put in the right place. Convenient lathe boards might also be found to be worth much more than they cost. The most valuable demonstration that it makes possible is that of showing to a man that the differences of accomplishment between men are not caused so much by their difference in power to run their machines at high speeds and to carry coarse feeds as in their power to arrange their movements in such a way that they are made with certainty, and in the quickest way.

The man who can and does do this can easily keep ahead of the crowd and still not have to hurry, but he must have an opinion on the subject and he must think.

Foremen have been blamed for showing partiality when they did not, just because it is not generally understood how much of a factor in getting out work rapidly the certainly planned movement is. I am pleased that the judicious use of the stop-watch is likely to give credit where it is due, and to show that the willingness that finds expression in saving time on the movements is just as valuable as that which finds expression in running at the highest attainable speed. As it usually is, the "lightning machinist" often gets credit for something that he is not doing. We all like to see the wheels go 'round, and when a man and his machine are always on the jump it seems to make us feel more satisfied than when he seems to be taking things easy. A good system of time keeping soon changes that, but it sometimes leaves a feeling that the man could do more than he is doing without any trouble, but the trouble with it is that we are apt to pick the wrong man. The stop-watch will show that we should spend our time with the "lightning machinist" to begin with, and educate him to the point where he knows which tool he wants before he reaches for it; to where once calipering eases his mind just as much as six times; to where he knows that he has tightened his tail center right without trying again; to where he does not have to try two speeds and three different feeds on the first six or seven inches of the cut, and then try them all over again if the boss happens to stop and look at him a few minutes.

The speed boss who has to see that the men run their machines at the proper speeds and feeds has a very simple proposition alongside of one who would have the job of seeing that the other operations were done in as nearly perfect a manner as possible.

After being ground thru the mill long enough it generally comes to most of us that there are a whole lot of different qualifications necessary in a man who is a "first-class" machinist.

W. OSBORNE.

The Strength of the Framework That Supports the Cascades at St. Louis.

We have received from Richard H. Phillips, chief engineer of the World's Fair at St. Louis, a letter in which he says:

"A note in your editorial correspondence reads as follows: 'It is reported that at no time will it be thought advisable to pour the full volume of water over the Cascades, because it is feared that the structure (of wood) which supports them would not stand the strain. At full capacity 90,000 gallons of water would flow over the Cascades per minute, there being three centrifugal pumps of 30,000 gallons capacity each, each driven by a direct-connected motor requiring about 2,000 horse-power to drive it.'

"As the framework and trusses carrying the Cascade fountains, basins and overflows were built under my charge, I am in a position to say that the framework was designed and built to take care of the full capacity of 90,000 gallons of water per minute and all the framework is now capable of carrying that amount without any danger whatever.

"Mr. Charles F. Foster is the chief operating engineer directly in charge of the pumps and, as I understand it, pumps the amount of water ordered by the management.

"I would like to correct the impression that seems to have gotten around that the Exposition has any fear in regard to the framework being able to carry what it was originally designed for."

Another report regarding this matter is to the effect that there is a great deal of vibration when these pumps and large motors are working and that it is this vibration which the supporting framework seems unable to withstand. But the makers of the motors and pumps would probably deny that there is any vibration about them when running, and the only sure thing about the matter so far is that the amount of water designed to pour over the Cascades does not actually pour. One reason that presents itself, so to speak, is that it costs a lot of money to make it pour.

Makers of steel shafting are reported to have held a meeting at Frontenac, N. Y., July 20.

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Water Meters.

The subject of water meters is receiving renewed attention now and the consensus of the most intelligent opinion on the subject is to the effect that each consumer of water, whether supplied by a municipal or privately owned plant, should have his water measured by a meter and should pay for what water he uses and no more. The arguments seem to be practically all one-sided on this question, and experience sustains them. In the absence of meters the rates are fixed to secure payment for the amount of water that experience shows will on the average be used in a house of a given size or having water connections of a given character and to a given number. As the consumer then has to pay the same amount whether he actually uses much or little water there is absolutely no pecuniary incentive to care in its use and as a pecuniary incentive is absolutely the only one that is operative with a good many individuals much water is wasted, not only by careless handling of faucets but by neglect of leaky fixtures, by allowing water to run continuously to avoid freezing of pipes that ought to be protected and by other methods and practises too numerous to mention. This makes the careful man with some conscience pay for the water wasted by the man possessing the opposite characteristics, and it has happened repeatedly that meters have done away with the impending necessity for enlarging city water works plants. This can be done without putting the rates at all high, and in fact most consumers find their water bills reduced, but the man who pays no attention to avoiding waste of water gives that matter some attention after paying a few water bills if not before. That is where the benefit to the considerate user and to the municipality comes in. As a matter of elementary justice, or of right and wrong, meters are demanded and their use is in every way expedient as well.

A British Visitor on American Shops.

An interesting article signed by G. Croydon Marks appears in a recent issue of *The Practical Engineer*, London. The writer was one of the British visitors who attended the meetings of the mechanical engineering societies at Chicago, and who also took advantage of the other opportunities of information, especially the visiting of various shops. It is not unpleasant to us to find this observing British engineer saying that the open inspection of works which was permitted "has done not a little toward encouraging our home engineers to believe that they are not by any means so laggard in modern methods as some of our non-technical contemporaries would lead the 'man in the street' to believe." The writer suggests that "possibly the difference in the methods of disseminating information thru the press in each country may, to some degree, explain the somewhat strong condemnatory notes and warnings that we have become almost accustomed to." The British manufacturers are not so ready to announce the big orders they receive for work and "the important internationally offered orders that somehow or other still manage to find their way into our home works are scarcely chronicled or known beyond the immediate district in which the works happen to be situated." As to the motives which were most operative in drawing the visitors who actually came upon the occasion of the meeting of the engineering societies, the writer says that "the desire for perfect friendliness and the manifestation of that thorough feeling of national good-will that exists" was probably the greatest incentive of all. And we are glad to concede that it was the best of all for all of us.

Speaking generally of the results of his shop observations, the writer says: "The average American workshop is apparently no better equipped than its fellow in England, and there are works in Manchester, Newcastle, Birmingham, Leeds and other towns that will compare favorably with any of the works visited in America in the matter of modern tools and modern methods. The speed of the tools was in some cases found to be less than those in use for similar work at home, and there appeared to be no more rush or feverish anxiety to work, either upon the part of masters or the men, than exists in the leading firms of this country. Indeed, in many places the visiting members were somewhat surprised to note that the adoption of high speeds and independent driving for large tools was not so general as at many of the much-misunderstood home works."

The writer notes the frequent use of the air-hoist in American shops, not as anything quicker or better, but as "an alternative method of lifting, as against hand or hydraulic power for machine shops, foundries and other shops, being an illustration of this variation of method." The writer was much pleased to note that at Cincinnati, "where high-speed work was in progress, such was accomplished by tools made from steel actually obtained from Sheffield." The writer says finally that "the visit, while productive of the very best and most cordial friendly relations, did not a little to encourage the visitors to consider that mechanical engineering is not yet by any means a lost or neglected art at home."

The Accident to the "St. Louis"

Has been mentioned elsewhere in our reading columns, also its cause and its temporary repairs.

We were first prompted to investigate by the crazy statements in the daily press. If such an accident as the wrecking of the No. 2 high- and low-pressure cylinders, their location being *forward* on the starboard side, could be caused by the loosening of a nut on one of the *after* cylinders, as one paper has it, then we are confident that there would be few men found who would care to risk their lives in the engine

room. A representative of this paper called at the office of the American Line and endeavored to obtain a permit to view the damaged engines and find out the cause, but he was gently but firmly turned down.

At first glance it would seem that the only reason for denying him the opportunity to see the disabled engines was that the company considered itself in some measure responsible, or had something it wished to hide.

Subsequent investigation proved that this was not the case, and it would have been to the American Line's best interests to have allowed the fullest kind of an investigation into an accident for which no one in its employment was in the least to blame.

It would further have been an excellent advertisement for the company to have had published every detail of how the splendid staff of engineers on board the "St. Louis" repaired the damaged engines in the short space of twenty-one hours. This latter they did get, and from this paper, tho for the information we published we are in no way indebted to the American Line.

The Moral Effect of a Machine.

At page 942 we published an item entitled "The Moral Effect of a Machine." The superintendent of the shop in which this machine was observed writes that we have not told the whole story; the rest of it being that the moral effect of this machine upon the workmen in the shop is better and more important than its effect upon those who supply castings. Before the machine was put in, there was constant complaint of hard castings and demands made for increased prices for doing piece-work upon them, on the ground of their hardness. Since the machine has been in, however, it is well understood that all complaints of hard castings will be referred to the machine and that the machine will tell an absolutely true, impartial and reliable story; the net result being that most of these complaints are now seen to have been based upon imaginary difficulties, or had no foundation in fact, and there are few of them coming in.

Several labor unions, including the International Association of Machinists, attempted to have the American Line steamer "St. Louis" held here for repairs required by the accident described elsewhere in this issue, but failed, as the steamer was allowed to sail but is reported to have carried no passengers. The protest against her sailing was made ostensibly on the ground of her alleged unseaworthiness, tho of course the real reason was that it was desired that the work of repairing the engine should be done here. The International Steamship Company, however, evidently preferred to have repairs made on the other side—presumably because they will cost less.

Some New Things

MOLDING MACHINE.

The machine here shown is called *the* "modern" molding machine. It can be used only with match plates and makes small light castings. The match plates are made and used in pairs, one plate to form

FIG. 1. TURNING THE REVOLVING TABLE.

the upper part of the mold and the other plate to form the lower part of the mold, so that each cycle of operations with the machine makes a complete mold. After the sand is put into the flasks the bottom boards are clamped, the revolving table is turned over, the mold then resting on a sliding platform, when the sand is pressed by pulling the long lever forward, the clamps are automatically released from the

FIG. 2. DRAWING THE PATTERNS.

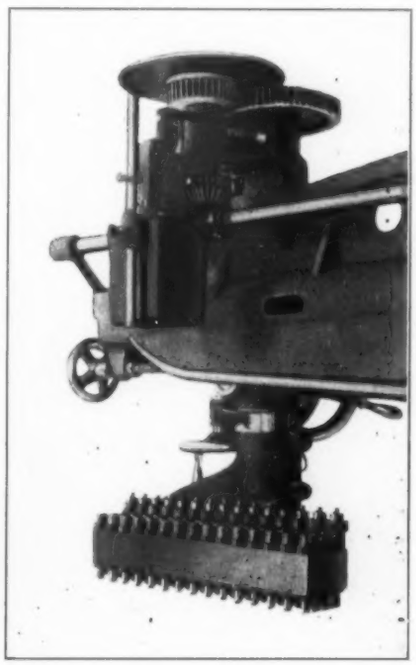
bottom board and the patterns are drawn by reversing the lever. The mold is then left free on the sliding platform and by pulling forward the shorter lever the platform is drawn out to a convenient position for the operator to finish and close the mold and lift it off. Fig. 1 shows the operator turning the revolving table, Fig. 2 shows the operation of drawing the pattern and Fig. 3 shows the closing of the mold. The machine takes flasks from 10x10 to 14x22 inches. It is made by the Arcade Manufacturing Company, Freeport, Ill.

MULTIPLE DRILLING ATTACHMENT.

The illustration shows a drilling device applied to a radial drill, permitting sixty holes to be drilled at the same time by operating the usual feeding levers. The main casting or head is clamped to the spindle sleeve, which is raised and lowered by means of its rack and pinion. The ra-

FIG. 3. CLOSING THE MOLD.

dial spindle runs loose in this head and, by means of teeth cut on the spindle next to the sleeve, drives the sixth gear in the first row of fifteen spindles, which mesh together. These spindles have 1⅝-inch



MULTIPLE DRILLING ATTACHMENT.

centers, and each of them drives three others in rows at right angles to the first row. Their centers are 1⅛ inches, in order to allow the teeth of their gears to pass each other as they run in opposite directions; thus thirty right- and thirty left-hand drills are used to do the drilling. With the aid of a graduated dial on the cross-screw and a table having its adjustment at right angles to the radial arm,

any number of holes can be drilled with accuracy down to ¼-inch center distances. This device is manufactured by the Mueller Machine Tool Company, Cincinnati, Ohio.

HIGH-SPEED LATHE.

This lathe has been designed with the object of taking advantage of the high speeds and coarse feeds possible with high-speed steel. The headstock of this lathe is entirely enclosed, all gears are keyed to the shafts and the shafts revolve in self-oiling boxes. The spindle has four geared changes of speed for each belt or

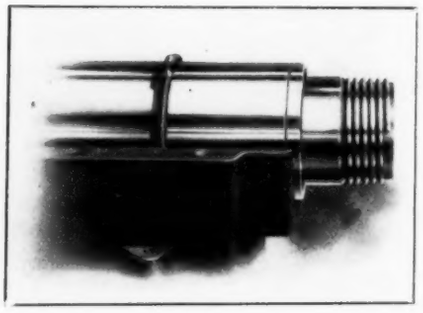


FIG. 1. FRONT BEARING OF SPINDLE WITH OILING DEVICE.

motor speed by sliding gears, changed by a hand-wheel at the front of the lathe, Fig. 6. The drive is by a single pulley, for a wide belt, mounted on the first gear shaft at the end of the headstock. The spindle is of crucible steel with a large hole thru its entire length and has three bearings. An oil recess has been provided in the center of each bearing and fastened to the spindle at such points is a ring

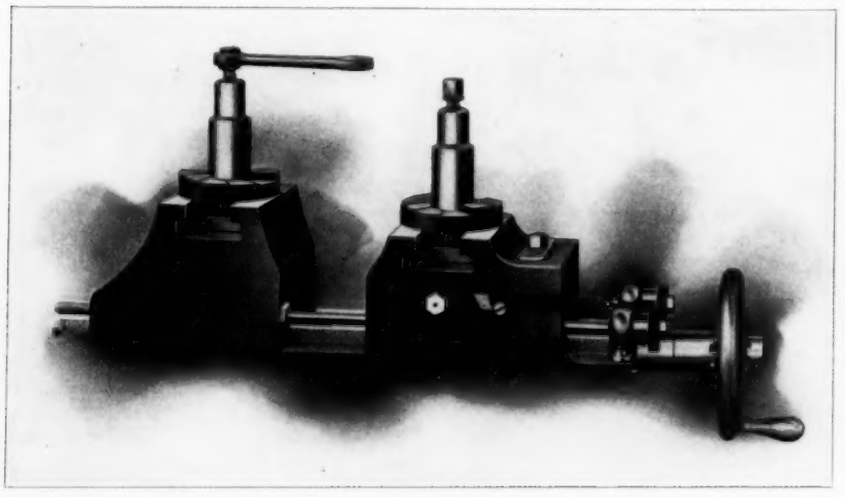


FIG. 2. TOOL RESTS.

(Fig. 1) in which are a number of small buckets which dip up the oil and flood the bearings. The end thrust of the spindle is taken by a gray-iron collar keyed to the spindle; next to this is a bronze collar, next a hardened steel collar, and next to this a bronze collar which bears against the housing of the head.

The free running gear shafts all run in long motor-type self-oiling bearings. The gears are of heavy pitch and wide face, well protected from dust and chips. The tail spindle is extra large and is secured by a pair of plug clamps fitting the under side of the spindle designed to avoid throwing it out of line in clamping. The bed is mounted in an oil pan with a tank from which the lubricant is pumped to be delivered in a stream on to the cutting tools. The carriage is gibbed to the bed at the front, back and between the shears and is provided with a gutter running around both back and front wings for carrying off the cutting lubricant. The bridge of the carriage has a bearing upon and against the inside edge of the front shear, thereby shortening the length of span and giving a bearing directly under the cutting tool. Tool rests are mounted on both the front and back of the carriage so that in a heavy reduction the cut can be divided between two tools, a cross-adjustment being provided on the front rest to facilitate setting the tools to work in unison (Fig. 2). This also allows a roughing cut to be carried by one tool, followed by a finishing cut with the other.

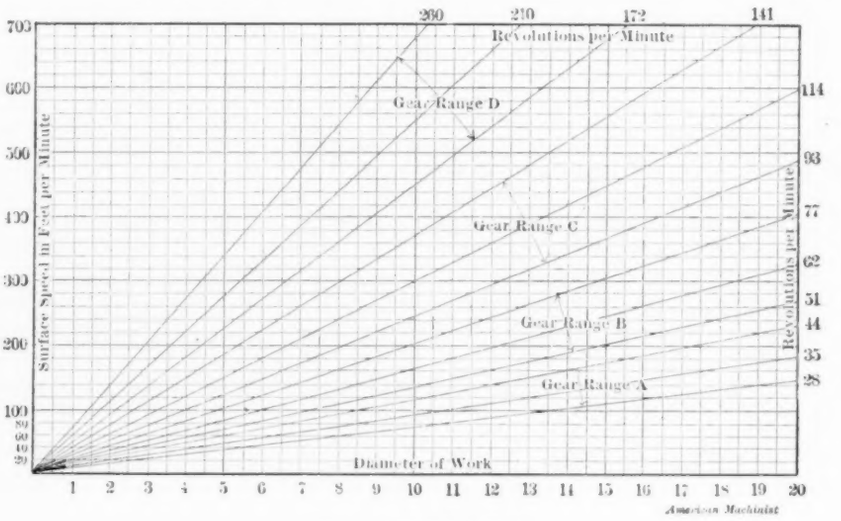


FIG. 4. SPEED RANGES.

The cross-feed hand-wheel is arranged to operate both rests by means of telescoping screws and a clutch at both ends of the hand-wheel hub, so that engaging the clutch on the outside allows operating the back rest and engaging the clutch on the inside operates the front rest. The cross-slide screws are covered to protect them from chips. The follower rest is very heavy and bolts to the carriage wings front and back; is provided with three long, heavily braced jaws with nurled knob screw adjustment which eliminates the possibility of setting them down to the work too tightly, as is usually the case where a wrench must be used. The jaws extend out from the body of the rest to a point close to the cutting tool, Fig. 3.

FIG. 3. FOLLOWER REST.

The apron is double and provides bearings at both ends of all studs. No gears in the apron revolve on studs. They are keyed to the studs and the studs revolve in bearings. The gears—with the exception of the friction gears—are drop-forged steel. The back plate of the apron is provided with a bearing surface which slides upon a steel strip or ledge let into the front of the bed. This affords a support

upon the bed directly in line with the strains which might tend to separate the rack and pinion while under a heavy load. Three changes of feed in either direction are secured at the apron. Adjustable automatic stops to the feed are provided by means of a stop rod on the front of the lathe along which collars may be adjusted and will reproduce with accuracy all the different lengths between shoulders that may be required (Fig. 6).

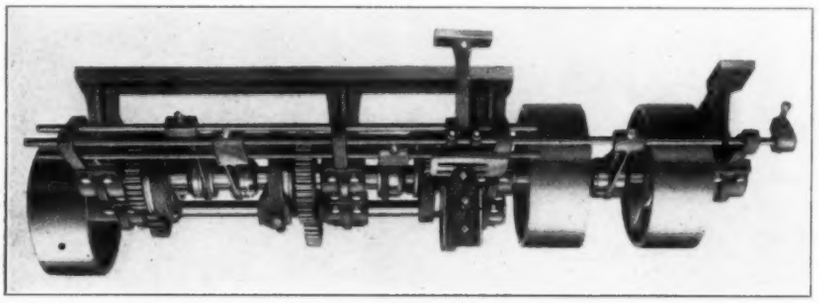


FIG. 5. THE COUNTERSHAFT.

This stop rod is also used for the controller rod in motor-driven tools and is operated for that purpose by a hand-wheel at the lower right-hand corner of the apron by means of spiral gears. The rotary motion of the rod operates the controller and does not affect the automatic stops, while a longitudinal movement acts upon the clutch engaging the feed rod at the head of the lathe and in no way affects the controller as a freely telescoping slip joint is provided between the stop rod and the controller. Belt driving is provided for by a countershaft with three or more speeds to suit the requirements. With a three-speed countershaft, the speeds secured are illustrated by the diagram, Fig. 4, which shows the surface speeds obtainable at any diameter of work up to the full swing of the lathe. The vertical lines represent the diameters, the horizontal lines the surface speeds in feet per minute, each diagonal line represents a spindle speed secured by a combination of one of the three countershaft speeds and one of the four gear ranges in the headstock. The intersection of the diagonal line representing a spindle speed, with the vertical lines representing a desired diameter will show—reading at the left margin—the surface speed obtained at the tool. The countershaft is designed to deliver three or six speeds with only one or two belts to the line shaft, as the case may be. It consists, as shown at Fig. 5, of two parallel shafts mounted in a self-contained framework, one shaft receiving the power thru either one or two friction pulleys and delivering it to the other shaft by means of either two or three pairs of gears operated by friction clutches. This arrangement permits a combination of one belt and three gear changes, giving three speeds, or two belts and three gear changes, giving six speeds at the second shaft. One shifter lever operates the belt friction, while another operates the three gear frictions.

Motor driving is provided for by direct connection of the armature shaft or motor back-gear shaft to the main gear shaft of the lathe by means of a positive clutch, which eliminates the necessity of the usual driving pulley on the motor and driven pulley on the lathe, the motor being mounted upon an extended and elevated cabinet leg designed for the purpose (Fig. 6). The controller is mounted on the same base between the motor and lathe, where it is easily direct-connected to the controller rod by a freely acting slip-joint coupling. Any type of motor can be used; with one of a constant speed, either direct or alternating current, the four changes of spindle speed are obtained which are provided for in the headstock gear ranges, while a motor having a 2:1 variation in speed will give to the spindle four times the number of speeds which may be secured by the motor controller.

At the speeds shown in the speed diagram the gears in the headstock of this lathe will safely transmit from 17 to 24 horse-power without overloading and therefore carry a cut in medium or soft steel equal to 13½ to 19 pounds of metal removed per minute at 100 feet surface speed. As any good motor will stand an overload of 75 to 100 per cent. for a short time, a 10 horse-power motor will, as a rule, cover the requirements unless the lathe is to be run continuously upon the heaviest cuts the machine will handle. Gear ratios from 2.73 to 1 to 48 to 1, swings over bed 20⅜ inches, with 10-foot

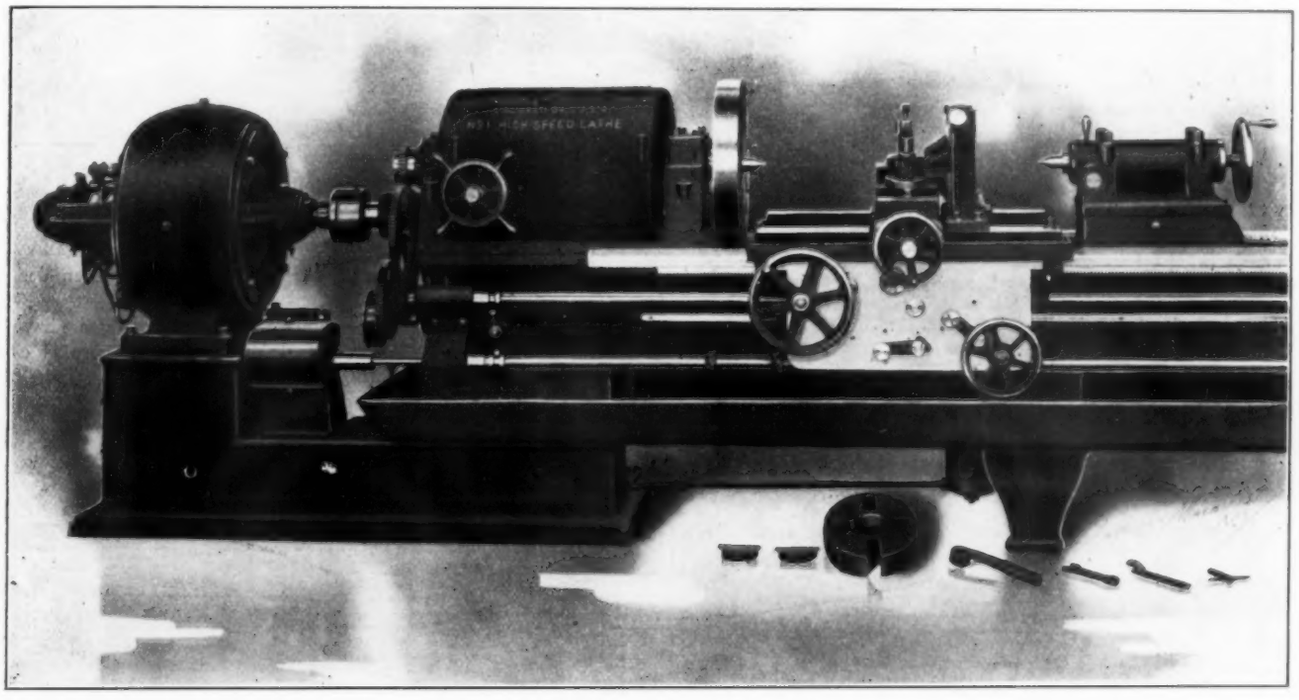


FIG. 6. HIGH-SPEED LATHE.

bed takes 56 inches between centers and weighs 6,500 pounds. This lathe is built by the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.

THE HEALD PISTON-RING GRINDER WITH AUTOMATIC CROSS-FEED.

The illustration, Fig. 1, shows a piston-ring grinder fitted with an automatic cross-feed. The machine with hand cross-feed was fully described at page 434, and the object of the present illustration is to show it with automatic feed, the details of which are shown by Fig. 2 and will be readily understood. There is a double clutch for reversing and the action of the trips *A A* is to first hold the spring abutting collar until the spring is compressed, when the further movement of the slide releases the trip and the spring immediately throws the clutch over and reverses. The machine is made by the Heald Machine Company, Worcester, Mass.

It seems that there is considerable indignation in Germany over the fact that the St. Louis Exposition authorities decline to pay the expenses of the German members of the various juries of awards. It had been assumed that these expenses would be paid and, upon discovering that they would not be, bad faith was charged.

We published an item a few weeks ago about a Milwaukee court which had issued an injunction forbidding certain concerns employing any others than members of a union. It seems this was based upon an agreement between the employers and the union and that the injunction was to sustain the agreement which the employers wanted to break or had broken. A higher court has decided that the agreement itself is null and void and has dissolved the injunction.

The oldest steam vessel in existence is said to be the "Norwich," a side-wheel Hudson River towboat which has been in continuous service since 1836. The steeple type engine has a cylinder of 40 inches by 10 feet.

Foreign Markets for American Machinery.

The preferential tariff agitation here has directed attention to the great amount of ignorance that prevails even among manufacturers themselves regarding trade matters in the United Kingdom. Especially are we ignorant of the extent to which we suffer by foreigners taking contracts away from our home makers. For instance, at a meeting of manufacturers and engineers in London, the other day, one well-known business man stated that he had conversed or corresponded with many engineering firms in Britain, but no one had been able to give him the figures for any year in regard to unsuccessful tenders the respective number of times and respective percentage margin by which competing Continental and English manufacturers took work for which he had quoted.

American makers of galvanized barbed wire for fencing should note that considerable quantities will be wanted in Iceland. During the years 1905 to 1909 an annual sum of nearly $30,000 will be devoted by the provincial treasury of that country to granting loans for the purchase of such wire for fencing farms. The United States Consul at Copenhagen would know what specification has been decided on.

American sewing machines have a good sale in Turkey, and there is every prospect of the trade increasing, as machines from the United States have the preference among buyers. The total imports from all sources amounted in 1903 to 900 tons, of which more than two-thirds were American and the rest from England, Germany, Austria and France. The machine which sold best—forming 80 per cent. of the total—is the hand machine. The pedal machine is used only in

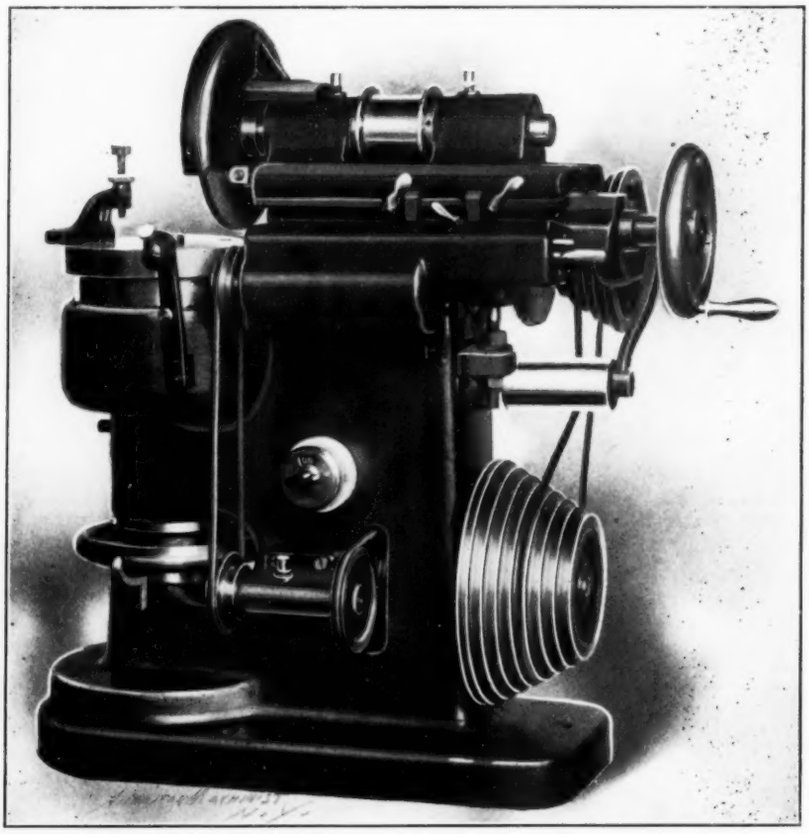


FIG. 1. HEALD PISTON RING GRINDER WITH AUTOMATIC CROSS-FEED.

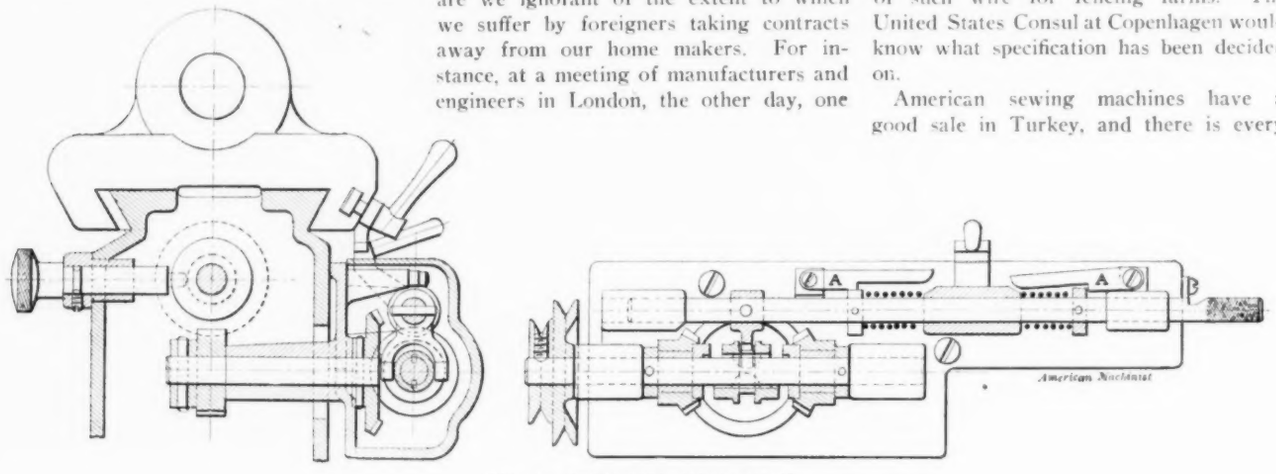


FIG. 2. CROSS-FEED MECHANISM.

workshops; special models are also supplied for tailors, saddlers, bootmakers, etc. Hand machines of German make, in a case, fetch from $9 to $16; pedal machines from $16 to $32; machines for tailors from $22.50 to $54. It should be noted that the German hand machine can be converted into a pedal machine, the pedals costing about $3.50. An American firm sells the ordinary hand models at $22.50; more finished ones at $32; machines for bootmakers and tailors are priced at from $40.50 to $54, and those for embroidery at from $40 to $80, 10 per cent. discount being allowed for cash.

The Servian Government has decided to have constructed two narrow gage railway lines, each about 112 miles long, from Belgrade to Valjevo and from Paratchin to Taetchar, respectively. A loan of $2,400,000 is to be raised for this purpose, and tenders for the roling stock, railroad materials, etc., will be invited later.

In Bulgaria, too, there is a chance of pushing trade. The municipality of Philippopolis is going to have an electric tramway service from that town thru the country, and the town itself is to be lighted by electricity. The United States Consul at Sofia would give details as to conditions of tender, etc., or they can be had from "M. le Maire, Philippopolis," sending $4.50 for same.

The engineering and hardware exhibition at Liege, Belgium, in 1905, promises to be worth attention: all kinds of machinery in motion will be shown, also high speed and pneumatic tools, mining implements, etc. There is also to be an exhibition of hydraulic machinery in Barcelona this winter open to foreign makers. As Spain is a good market for this class of machinery, it would be well to make a show there.

Makers of traction engines and motor wagons will find a study of the South African market will repay them, as their use in that country is largely on the increase, a considerable quantity being wanted for mining industry alone. Steam motors will of course always be in great request, but the advantages of gas and oil motors are generally recognized, and there are many places where their employment is indispensable. In many districts the only available water rapidly incrustates, rendering the use of steam boilers undesirable. Consequently this leaves a large margin for the use of gas or oil motors. The former are likely to be used in towns, as it would be difficult to obtain the gas in the country districts. A considerable amount of ignorance prevails throughout South Africa regarding the use of gas and oil motors, largely due to the want of knowledge of the mechanism in such manufactures. It would repay any firm thinking of making a feature of the gas and oil motor trade to spread a knowledge of the working of such motors and advertise their many advantages. It should be carefully noted that it is advisable to send only the best class of machines, of solid finish, as repairing shops are to be found only in the large towns. Simplicity of construction and quickness of repair are essential features of any motor if a quick and large sale is desired. It is a trade that is at present only in its infancy, and is one capable of great developments. F. C. C.

London.

Business Efficiency and Fan Motors

A little episode that occurred under our observation the past week during the hot weather attested the value of the humble fan motor in maintaining and enhancing business efficiency. A young lady overcome by the heat in an office where there was no fan motor was quickly revived by the application of the breeze of one brought in from an adjoining office. This was excellent, but the workers in the office deprived of its fan began very soon to suffer, and it was not until another fan motor not in use elsewhere had been installed for them that they were able to resume work and clean it up with dispatch. The consideration of the fan motor as a luxury is not unusual, but we believe it still to be far from common to put it alongside the typewriting machine or the copying press or the telephone as a real and powerful agency for expediting affairs and for keeping individuals and office staffs up to the normal pitch of accomplishment during the long term of summer enervation. On this basis the small cost of the fan and of the current to operate it shows a large margin of profit. It is perhaps late in the day to be talking about the virtues and merits of fan motors, but there remain a great many hot offices and stuffy rooms into which they might be introduced with incontestable advantage.—*Electrical World and Engineer.*

No one who does office work in New York or in a similar climate and whose office is so situated as not to get a full supply of breeze can afford to do without the motor fan. It enables one to work energetically under conditions that would otherwise make energetic work impossible.

Personal.

The editor would like the address of Har. McVeen.

E. F. Du Brul, who resigned from the commissionership of the National Metal Trades Association recently, has been presented with a handsome loving cup by the members of the Administrative Council, as a token of their esteem and appreciation of his services.

Wilfred J. Thompson, who was formerly with the Westinghouse Machine Company at Pittsburg and later foreman of the toolroom of the Betts Machine Company, has gone to Manchester, where he is engaged on turbine work with the British Westinghouse Electric & Machine Company.

President A. C. Humphreys, of Stevens Institute of Technology, was thrown from a horse he was riding, on July 22, and dragged by the stirrup for a considerable distance. His left arm was broken below the shoulder, but he was able to walk to his office in the Institute, about a quarter of a mile away, where he was attended by a physician.

Manufacturers.

The Baltimore & Ohio elevator E. at South Chicago, Ill., has been burned.

James Hutchison has been erecting a building at Union, Ore., for a foundry.

Fire has damaged the plant of the Indianapolis (Ind.) Drop Forging Company.

The plant of the Evansville (Ind.) Pressed Brick Company has been damaged by fire.

The Commercial Club has obtained a mattress and bed-spring factory for Terre Haute, Ind.

The Beals & Torrey Shoe Company, Milwaukee, Wis., will build a plant at Watertown.

The large plant at Montgomery, Ala., of the Alabama Rift Flooring Company has been burned.

F. S. Loeb, of Seattle, Wash., may build a new sawmill at or near Clipper, to replace a burned one.

The plant of the Stimpson Computing Scale Company, Elkhart, Ind., is moving to Detroit, Mich.

The Piano & Organ Workers' International Union is considering the matter of starting a piano factory.

The Empire Plow Company, at Ensley, Ala., is making an addition to its wood-working department.

The main building of the Schoepfle Manufacturing & Lumber Company, Sandusky, O., has been burned.

A plant of the Uvalde Asphalt Paving Company, of New York city, in Jersey City, N. J., has been burned.

Plans for the erection of a general factory building by the Grand Rapids, Mich., Board of Trade are maturing.

A four-story addition, 190x40 feet, will be built to the plant of the Fyrberg Arms Company, Hopkinton, Mass.

Bellevue, O., expects to hold a special election August 9, to vote on bonding for a municipal electric light plant.

The L. Wolff Manufacturing Company, Chicago, Ill., plumbers' supplies, has taken out a permit for an addition.

Fire has destroyed the plant of the Metal Shingle and Siding Company, Preston, Ont. The warehouse was saved.

The Midland Manufacturing Company, implements, Tarkio, Mo., is making extensive improvements at its plant.

The plant at Greasemersville, near Allentown, Pa., of the Princes' Metallic Paint Company, has been burned.

The Ideal Acetylene Gas Company intends to build a plant at Yankton, S. D., for the manufacture of gas machines.

The Northwestern Lumber Company, of Eau Claire, Wis., is establishing a brick-manufacturing plant at Stanley.

The Vincennes (Ind.) Bridge Company is starting to build an addition, 210x90 feet. The machinery has been secured.

Selz, Schwab & Co., Chicago, are planning to build a new shoe factory, and have been considering offers from different towns.

The Independent Milwaukee (Wis.) Brewing Company will erect new buildings, including an engine-house, cooper shop, etc.

Plans have been drawn for a plant which

Michael J. Green, a silk manufacturer of Paterson, N. J., will erect at Norwich, Conn.

The Royal Envelope Company, incorporated by Wm. R. Yeager *et al.*, will probably buy and equip a plant at South Allentown, Pa.

Fire has caused a slight damage to the plant of the West Haven (Conn.) Manufacturing Company, manufacturer of hacksaws, etc.

The contract has been let for an additional story to a building of the Scovill Manufacturing Company, brass goods, Waterbury, Conn.

The Spring River Power Company is damming the river at Lowell, Kan., for an electric plant to supply power in the mining district.

The Ritchie-Clarke Company, Minneapolis, Minn., manufacturer of folding beds, may build a new plant at Eau Claire, Wis., or elsewhere.

The Vaughn-Rood Machine Company, manufacturer of leather machinery, is getting out plans for the enlargement of its plant at Peabody, Mass.

The Red Jacket Manufacturing Company, pumps, Davenport, Ia., thinks of erecting a new foundry and other shops additional to its present plant.

The Joseph Schlitz Brewing Compnay, Milwaukee, Wis., will build a three-story, 62x64-foot addition to the boiler plant, with smokestack 365 feet high.

The roof of the Westinghouse Electric & Manufacturing Company's new foundry at Hamilton, Ont., collapsed, and several workmen were injured.

It appears that the Limestone Manufacturing Company, Gaffney, S. C., does not expect to double its plant in the near future, as we stated in a late issue.

Contracts have been let for an addition to the plant of the Elgin National Watch Company at Elgin, Ill. It will be five stories high and cost $350,000.

The contract has been let for a factory building, to be erected on Willson avenue, Cleveland, O., for De Mooy Bros., manufacturers of gasoline engines.

At Rock Hill, S. C., the Chicora Cotton Mills and Highland Park Manufacturing Company are thinking of using electric power from the Catawba River plant.

Austin, Tomlinson & Webster Manufacturing Company, manufacturer of wagons and springs, Jackson, Mich., proposes to reorganize and to build a new plant.

Buildings entailing an expense of about half a million dollars extra will be added to the plant being built this year at or near Sioux City by Armour & Co., of Chicago.

The Webber-Costello-Fricke Company, Chicago, Ill., manufacturer of school supplies, intends to build a four-story, 60x200-foot plant, with power-house, at Chicago Heights.

A 1,500-barrel cement factory will be built at Charlevoix, Mich., by the Standard Portland Cement Company, of Detroit, at a cost of $450,000. Work will commence August 15.

The Carbondale (Ill.) Foundry & Machine Company will establish a plant about three miles east of Carterville for the manufacture of mining machinery and tools and other machinery.

It is stated at Cape Vincent, N. Y., that the Pentecost Lumber Company (of Watertown) is tearing down the old Burnham grist mill, preparatory to erecting a power-house on the site.

The York (Pa.) Manufacturing Company, ice and refrigerating machinery, will build an addition to the malleable iron foundry and change the location of its tin and pattern departments.

Ground is being broken at Monessen, Pa., for the new American seamless tube plant, the projectors of which are Pittsburg capitalists. The plant will cost in the neighborhood of $500,000.

Armour & Co., Chicago, Ill., will construct a building to take the place of their recently burned soap factory in the stock yards. The new structure will be fireproof, six stories high, 306x125 feet.

W. I. Wellman, of Huntsville, Ala., has interested a party of New York capitalists in the establishment at Huntsville of a plant to convert waste from local cotton mills into rope and other products.

Work is about to be commenced on a new woolen mill at Abbott Village, Me. It is to be erected by an interest of Charles C. Emerson and others, of Bangor, and will be double the size of the one burned.

The Scott & Oliver Manufacturing Company, Knoxville, Tenn., is pushing to completion one of the largest foundry and machine shop plants in the South. It intends to bid on work for the Panama canal.

Application has been made by the American Oak Leather Company, Cincinnati, O., for a permit to erect a seven-story concrete factory on Flint street, between Dalton and McLean streets, at a cost of $100,000.

John Peck, Sterling, Ill., planing miller, has closed an $85,000 contract with the government for rifle stocks, and was expecting an order from the Winchester people. He intends to build a new plant, doubling his capacity.

The Pittsfield (Mass.) Spark Coil Company is in receipt of large orders almost daily, and is accordingly enlarging its plant as rapidly as conditions permit. It is possible that the concern will occupy more roomy quarters before long.

The De Kalb Cotton Mill, of Camden, S. C., will be remodeled and put in operation, and probably considerable machinery will be added. The Wateree Manufacturing Company has been formed to take over and continue the plant.

A project involving the erection of a beet sugar factory in the Calgary, Man., district has been submitted to the Canadian Pacific Railway Company. Senator Gustavue Theden, of Minneapolis, Minn., represents the syndicate.

Fire has destroyed surface improvements of the American mine at Gladstone, Colo. The loss is $125,000. The mine is part of a group which is owned in Boston and Waterville, Me. Henry V. Soule, of Boston, is president.

The Tabor Manufacturing Company, of Philadelphia, Pa., has secured substantial orders for molding machinery to be installed in the Woolwich Arsenal, near London, and in the shops of the Midland Railway Company, at Derby, England.

W. W. Tyler & Sons, North Tonawanda, N. Y., are about to construct a saw and planing mill and a turpentine factory in connection with their timber possessions in Florida. An electric plant will be built to supply light in the several mills.

Columbus, Miss., expects to have a new yarn and cordage manufacturing enterprise. B. N. Love, secretary of the Tombigbee Cotton Mills, at that place, will sever his connection with that industry and become manager of the new mills.

Enrique Silva, of Penjamo, Guanajuato, Mex., has applied for a concession to utilize 4,000 liters of water per second from the River Angulo or Zacapu, in the State of Michoacan and district of Puruandiro, for generating motive power.

The big plant of the Canfield East Lake mill, at or near East Lake, Mich., has been burned. It was purchased a few weeks ago by the Peters Salt & Lumber Company, of that place, and was being operated under lease by McKillip & Hopper.

Secretary McDowell of the directors of the Danville, Ill., Chamber of Commerce, is in touch with a manufacturer who may locate there and employ about 100 skilled men. Car fittings for steam and electric roads, electrical supplies, etc., would be manufactured.

Sir Frederick Borden, Canadian Minister of Militia, has under way a contract with the English firm of which Sir William Armstrong is head, for the construction of an ammunition factory in Ottawa, capable of turning out 20,000,000 rounds of ammunition a year.

Representatives of the Walworth & Neville Manufacturing Company, telegraph and telephone cross arms and pins, with headquarters at Chicago, have secured nine acres or more at St. Paul, Minn., where the company expects to establish a manufacturing and distributing plant.

Peoria, Ill., expects to be the location of an independent glucose plant to be erected by Chicago capitalists represented by William Treadway, of St. Louis. S. J. Butler, of Chicago, recently vice-president of the Corn Products Company, is said to be interested in the movement.

The Globe Iron Works Company, Minneapolis, Minn., has had plans prepared for a new plant to be erected at Menomonie, Wis., The main shop will be about 50x180 feet; the foundry, 56x65; pattern shop, 40x32; shipping- and stock-room, 54x72; boiler-house, 48x52, and office, 30x40.

It is reported by way of Milwaukee, Wis., that a mill costing $300,000 will be erected by the Eagle Portland Cement Company, which has been incorporated with a capital of $600,000. Between 600 and 700 acres of land have been obtained in the town of Eagle, twelve miles from Waukesha.

J. D. Kennedy, of 46 Randolph street, Memphis, Tenn., may move a 15,000-spindle cotton mill to Shreveport, La. J. C. Vance, of 3665 Main street, Memphis, Tenn., has submitted a proposition to the Progressive League at Shreveport to move his 5,000-spindle cotton mill there from Chattanooga, Tenn.

The Lawrence Cordage Works, 46 South street, New York city, which recently came into possession of property formerly owned by the New Jersey Zinc Company, in Jersey City, N. J., has begun to make extensive improvements. Old structures will be replaced with several new ones for manufacturing purposes.

The Foster-Armstrong Company, Rochester, N. Y., piano manufacturer, has let contracts for the erection of a large plant at Despatch. It is said that among the buildings will be foundry and wood-working departments and that two 250 horse-power steam turbines and 1,000 horse-power of boilers will be installed in the power plant.

Plans have been filed for the construction of an immense power-house for the New York Central & Hudson River Railroad Company, on One Hundred and Forty-ninth street, New York city, 95 feet west of Long Island Sound. The plans contemplate a three-story brick structure, 236x166.4 feet, to cost $450,000.

Perrysburg (O.) men have organized the Perrysburg Tile & Brick Company. A gas engine will provide power. The plans for the works are being drawn by a Pittsburg, Pa., construction company. The officers of the enterprise are: Geo. Munger, president; A. J. Witzler, vice-president; Chas. H. Hoffman, secretary, and H. R. Roether, treasurer.

The National Steel & Manganese Company, a Washington, D. C., concern, has, through its attorneys, purchased 8,000 acres of mineral lands in Augusta County, Va. The company proposes to immediately erect steel plants. Those interested in it include Anthony Gaegler, vice-president of Home Savings Bank, Washington; Alex. S. Clark, secretary Home Savings Bank, and others.

The stockholders of the United States Corn Products Company have been notified that the directors have plans for the reconstruction of the Des Moines (Ia.) starch works, burned two years ago. The cost of the building is said to be estimated at $235,000. The meeting of stockholders will be held in January, when the decision as to whether the factory will be rebuilt will be made.

A new power canal enterprise, involving an expenditure of $10,000,000, was put under way when the Niagara County Irrigation & Water Supply Company filed at the County Clerk's office, at Lockport, N. Y., a map of the proposed canal, the route of which is from La Salle, where it takes in the water of Niagara River, to the Devil's Hole, below the falls, where there is a drop of 300 feet. President Wortham is quoted as stating that the financial end of the enterprise has been arranged through New York parties. It is stated that the plant will produce 150,000 horse-power.

The Belton (S. C.) Power Company has been formed with $100,000 capital. It will develop about 5,000 horse-power from the Saluda River and transmit this to established cotton factories and mills to be built in that section. Electricity for lighting the town and for supplying the power to furnish water will also be supplied. John B. Adger, of Charleston, S. C., is president and treasurer; R. A. Lewis, of Belton, is vice-president, and James B. Adger is secretary. Mr. Lewis will arrange for a cotton mill in connection with the company. He proposes building a plant of at least 25,000 spindles, but will probably not begin construction work on it before next spring. The Belton Mills, at Belton, and the Williamston Mills, at Williamston, S. C., have already contracted to use the power to be developed.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Estimates furnished on pattern work. Globe Pattern Works, Kalamazoo, Mich.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Copies July 27 and August 3, 1899; state price. Address Box 154, AM. M.

Special machinery to order. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Second-hand vertical boring mill, 60 or 72 in.; must be in good condition. Ft. Scott Mfg. Co., Ft. Scott, Kan.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

A director of methods for increasing machine shop output solicits engagement; vast experience; excellent record. Box 104, A. M.

Will purchase, or manufacture on royalty, patented machine of merit. Address, with full particulars, Box 176, AMER. MACHINIST.

Addressing machines without type; high speed; run by motor or foot power; write for the picture book. B. F. Joline & Co., 123 Liberty st., New York.

Wanted—Machines to build or repair, or other articles in machinist line to manufacture by day or contract. Johnson, 18 Dunham Place, Brooklyn, N. Y.

Wanted—By fully equipped and modern machine shop, special machinery or machine parts to build by contract or day work. Address Ingle Machine Co., Rochester, N. Y.

Steam Turbine.—A. B. Van Wegen, 21 W. Wilford st., Grafton, W. Va., wishes to correspond with capitalists or company who are interested in turbines; a 12 in. wheel, 25 buckets, ¾ in. wide, with 80 lb. steam boiler, at 3,000 revolutions per minute, gives 7 1-10 brake horse-power; the velocity of steam is all expended on the wheel.

For Sale.

Canada.—Double-blade hacksaw; cuts in half time; Canadian patent for sale; particulars. F. B. Wright, 177 Broadway, New York.

Patent for sale, or party wanted with best facilities to build small labor-saving machine; indorsed by unions. Box 164, AM. M.

For Sale—One Sellers 8 ft. gap steam riveter, for 1 in. rivets; good as new; can be seen and tested at our works. Chambersburg Engineering Company, Chambersburg, Pa.

For Sale—1 Farrell Foundry hydraulic pump and press; 800 tons; cost $1,950; will sell very reasonably; perfect condition. H. M. Crowell Mfg. Co., 6th ave. and 13th st., Newark, N. J.

For Sale—Two 50 H.-P. General Electric standard type "L," three-phase, 220-volt, 24-cycle, alternating current motors; 800 R. P. M.; used only few weeks; absolutely good as new. Box 127, AMERICAN MACHINIST.

For Sale—An old-established pattern shop; excellent reputation; centrally located in New York city; equipped with up-to-date woodworking machinery; splendid opportunity for energetic party; selling because another line requires more attention. Address "Patterns," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Traveler—Special machinery and machine tools—desires position in United States or for Canada; good connections. Address Drawer U, Sarnia, Ontario, Canada.

CONNECTICUT.

Wanted—Position as superintendent or general foreman by a thorough, practical mechanic with 12 years' experience; age 39; member of A. S. M. E. Box 116, AM. MACH.

Competent machine shop foreman desires change; 20 years' practical experience; thorough mechanic; reference as to character and ability; age 42. Box 170, AMER. MACHINIST.

ILLINOIS.

Superintendent or foreman; experience steam, gasoline engines and mining machinery. Address T. Kellar, 245 63d Place, Chicago, Ill.

Draftsman (mechanical engineer), with experience in steam engines, hoisting and mining machinery and wire rope tramways, wants position. Box 157, AMER. MACHINIST.

I am a practical machinist; have had charge of men for the past 8 years; the last 4 years of this time have held the position of general shop superintendent for a company employing 200 men and over in the manufacture of machine tools, presses, dies and special machinery; I am 35 years of age, strictly temperate and of good executive ability, and am not afraid of hard work and responsibility. Box 155, AMER. MACHINIST.

MASSACHUSETTS.

Draftsman, a technical graduate, with nearly 4 years' experience, desires a position in an engineer's office or as a designer for a manufacturing concern. Box 156, AM. M.

MICHIGAN.

Experienced foreman patternmaker, now employed, desires to change. Box 122, A. M.

NEW YORK.

Experienced mechanical draftsman wants position. Box 171, AMERICAN MACHINIST.

Mechanical draftsman, familiar with shop work, desires position. Box 166, AM. MACH.

Machinist, toolmaker, 30, wishes to take up automobile work; had charge. Box 184, A. M.

Superintendent or general foreman, capable systematic and experienced, open to correspond. Box 143, AMERICAN MACHINIST.

Mechanical draftsman (20), 2½ years' experience with machine drawings, would like a position. Box 165, AMERICAN MACHINIST.

Experienced mechanic will contract to design, construct and put in operation automatic machinery. Address Box 168, AM. M.

Mechanical draftsman wishes position with engineering concern; 6 years' experience in shop and drafting room; references. Box 162, AMERICAN MACHINIST.

Situation wanted as foreman or erecting engineer; experienced in high-speed engines, gas and automobile engines. Address S., care AMERICAN MACHINIST.

Practical steam-fitter wishes position as foreman; can furnish references from present employers. Address C. MacNaughton, care AMERICAN MACHINIST.

Experienced engineer and draftsman, German, 26 years old, desires a position with a manufacturing or constructing company. Box 161, AMERICAN MACHINIST.

Expert systematizer, young man, 10 years' experience, shop and cost systems, reliable manager, desires new field to systematize. Box 146, AMERICAN MACHINIST.

Foundry superintendent or foreman wants position; experienced; engine or general jobbing; East preferred; references. Address Box 173, AMERICAN MACHINIST.

Situation wanted as general or assistant foreman, by a man of 20 years of experience, who has been foreman and has best of references. Box 178, AMERICAN MACHINIST.

Mechanical-electrical draftsman and foreman wishes a change to vicinity of New York; 15 years' experience; A1 designer; mechanical-electrical graduate. Box 141, AMERICAN MACHINIST.

Expert mechanic, progressive (36), experienced in light and medium weight duplicate machinery, first-class reference as general foreman, desires responsible position. Box 182, AMERICAN MACHINIST.

Mechanical engineer will be open for engagement in September as superintendent or master mechanic; technical education and large experience in the manufacture of small interchangeable machinery, sheet metal goods, etc. Address Box 144, AMER. MACHINIST.

Young American mechanical engineer, age 28, who has proven his ability to operate a small machine shop with high efficiency, would like to get in with a concern whose policy is to push business and grow; am a good designer. Address Box 140, AM. MACH.

PENNSYLVANIA.

Draftsman, experienced also in designing, M. E. graduate, desires any position. Box 159, AMERICAN MACHINIST.

Position as chief draftsman or assistant superintendent, by mechanical engineer, experienced in rolling mill, special machinery, general work. Box 131, AMER. MACHINIST.

Mechanical draftsman, 7 years' experience; can combine mechanical and structural work to good advantage; technical training; designing or checking. Address Box 158, A. M.

Position wanted as general manager, superintendent, assistant superintendent or foreman, by man who has held those positions; at present general manager of manufacturing company. Address Box 183, AM. MACH.

Situation desired as foreman or assistant superintendent; technical education; experienced machinist and toolmaker; up-to-date draftsman; executive ability; western Pennsylvania or Ohio preferred. Box 160, A. M.

Wanted—Position as assistant superintendent; technical education; 10 years' experience as machinist and designer in heavy and light machine tools and interchangeable work; familiar with up-to-date methods, hustler and hard worker; first-class references. Box 169, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

A practical machinist and graduate mechanical engineer, with 8 years' thorough practise, wishes position as instructor or assistant professor; references furnished. Box 181, AMERICAN MACHINIST.

WISCONSIN.

Junior draftsman wishes position with small concern; Pennsylvania or Ohio preferred. Box 172, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Seven first-class toolmakers; state experience, wages wanted and how soon you could report in Quebec. Ross Rifle Co., Quebec, Canada.

Wanted—A first-class man as superintendent and managing director of a machinery and foundry works, who can become financially interested; must be thoroughly experienced in machine tools, presses and special machinery. Apply at once to Box 152, A. M.

ILLINOIS.

Wanted—A1 foreman of tool department; must be able to design tools, dies, jigs, etc.; able to handle 20 men; give references, experience, salary, etc. Box 174, AM. MACH.

Wanted—First-class man, experienced in designing coin-operating machines, for experimental work; must be first-class mechanic; give experience, wages wanted, etc. Box 175, AMERICAN MACHINIST.

Traveling salesmen, handling engineering supplies, can, by gathering information in their territory for us, augment their present income easily and not interfere with their present work; nothing to sell. Box 180, A. M.

MASSACHUSETTS.

Wanted—An experienced toolmaker on general work. Boston Gear Works, Boston, Mass.

MICHIGAN.

Wanted—A recent graduate as assistant in a technical school mechanical engineering laboratory and drawing room. Box 153, A. M.

Wanted—Experienced draftsman; must be a good mechanic, a reliable man and have had experience designing jigs and fixtures for manufacturing first-class machine work on the interchangeable plan by the latest modern practise; state age, experience, wages and references; plant pleasantly located in Middle States. Address Box 179, AM. MACH.

NEW YORK.

Wanted—Young man to act as foreman in machine shop; technical education desirable; must have business ability. Box 167, AM. M.

Wanted—Immediately, mechanical draftsman for out-of-town work; must be experienced in machine tool design. Send all particulars to Box 185, AMERICAN MACHINIST.

A superintendent, also a mechanical engineer, desired for an old, prosperous engine manufacturing company; investment of $3,000 to $5,000 required, but satisfactorily guaranteed; exceptional opportunity. Box 177, AMERICAN MACHINIST.

Machine shop foreman wanted; energetic, practical, up-to-date man of more than ordinary executive and mechanical ability; under 40 years of age preferred; location, New York city; light and medium experimental and jobbing work. Address "Permanent," care AMERICAN MACHINIST.

PENNSYLVANIA.

Toolmaker on gasoline engines and carburetors wanted. State experience and wages. Bradford Motor Works, Bradford, Pa.

A competent machine hand and a floor hand, experienced on pipe threading and cutting machines. Standard Engineering Works, Ellwood City, Pa.

Wanted—Accountant to keep books and manage office of general machine and engine works; must be experienced and systematic in cost keeping. Kenney & Co., Scottdale, Pa.

Wanted—Good, active Corliss engine and machinery salesman, capable of estimating on machine work, to travel in the Pittsburg district. Address Kenney & Co., Scottdale, Pa.

Wanted—One or two thoroughly experienced, competent men to erect and test steam engines, both in the shop and on the road; state fully age, experience and wages expected. Address "Automatic" care AM. M.

The Monotype Company maintains a school to train young men to meet the constantly increasing demand for operators of its type casting and composing machine. These operators have done so well that it receives more applications for places than can be filled. In making selections these qualifications carry most weight: common sense, type foundry experience, printing office experience, automatic machinery experience. Full particulars will be furnished to inquirers who furnish the same information about themselves. The Lanston Monotype Machine Co., 1231 Callowhill st., Philadelphia, Pa.

WEST OF MISSISSIPPI.

Boltmakers wanted on Pawtucket machines; Middle West. Box 163, AMER. MACHINIST.

Machinist for general repair shop; all kinds of work; permanent job; union shop; good hand wanted. Washington Machinery & Supply Co., Spokane, Wash.

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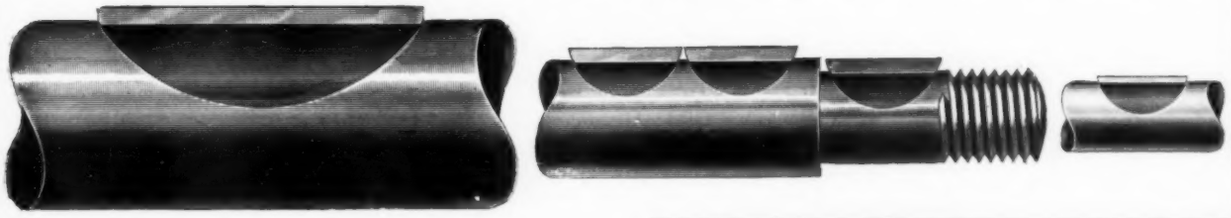

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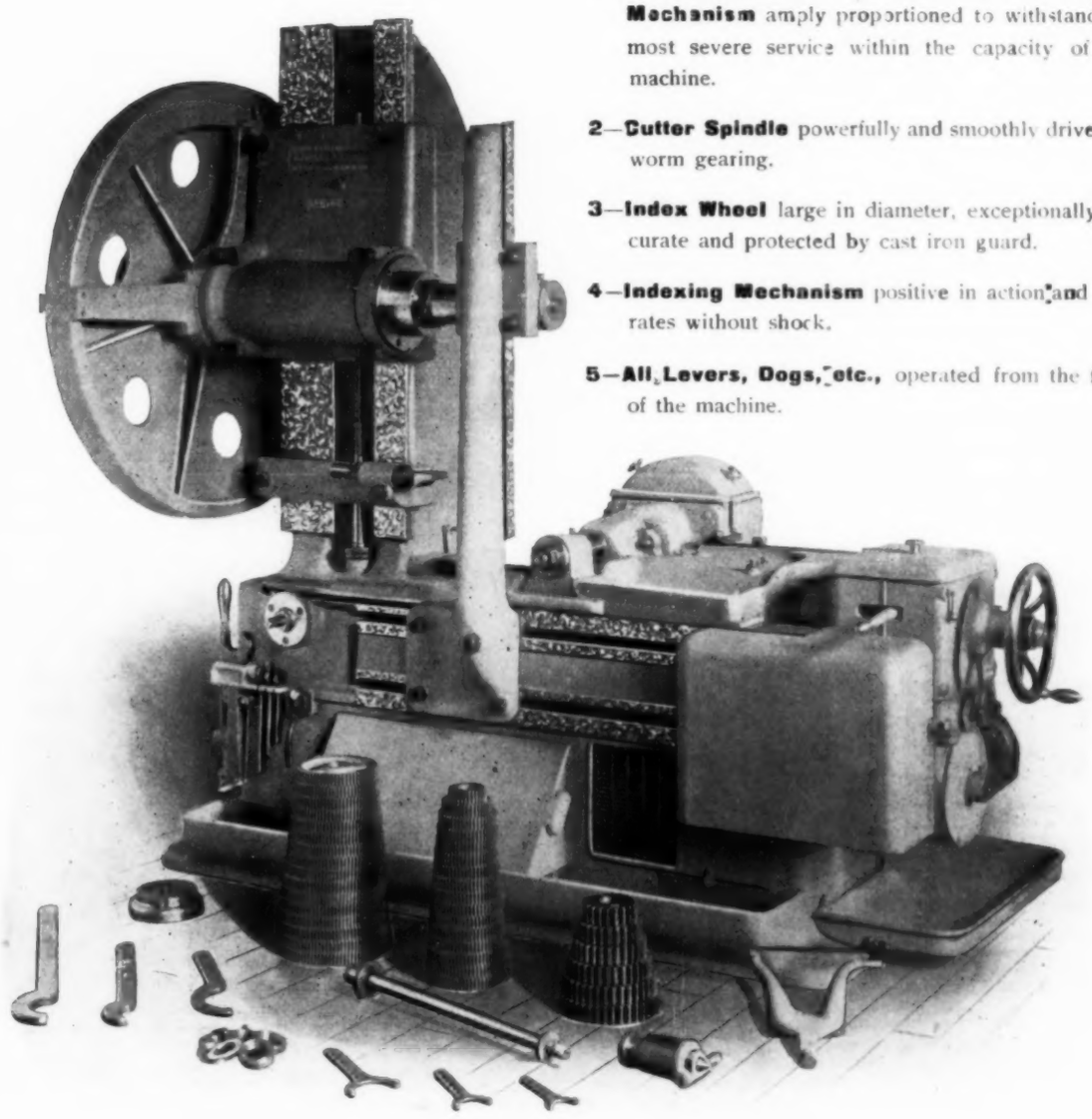

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Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Goodell Mfg. Co., Greenfield, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Toronto Machine Co., Toronto, O.

Diamond Tools
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Crucible Steel Forge Co., Cleveland, O.
Perkins Mach. Co., Warren, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Beskin Mfg. Co., Canton, O.
Obermayer Co., S., Cincinnati, O.
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments
Altneder & Sons, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Flather Planer Co., Mark, Nashua, N. H.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
National Auto. Tool Co., Dayton, Ohio.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Co., J. R., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Burke Machinery Co., Cleveland, Ohio.
Cincinnati Mach. Tool Co., Cin., O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Machine Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Co., J. R., New York.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Niles-Bement-Pond Co., New York.

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Greene, Tweed & Co., New York.
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Keystone Electric Co., Erie, Pa.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
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Sprague Elec. Co., New York.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

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McGeorge & Sons, Cleveland, O.

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Olds Gasoline Engine Works, Lansing, Mich.

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Backus Water Motor Co., Newark, N. J.
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Mietz, August, New York.
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Olds Gasoline Engine Wks., Lansing, Mich.
Regal Gasoline Eng. Co., Coldwater, Mich.
Struthers-Wells Co., Warren, Pa.
Woolley Fdry. & Mach. Co., Anderson, Ind.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
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Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach Co., Geo., Racine, Wis.

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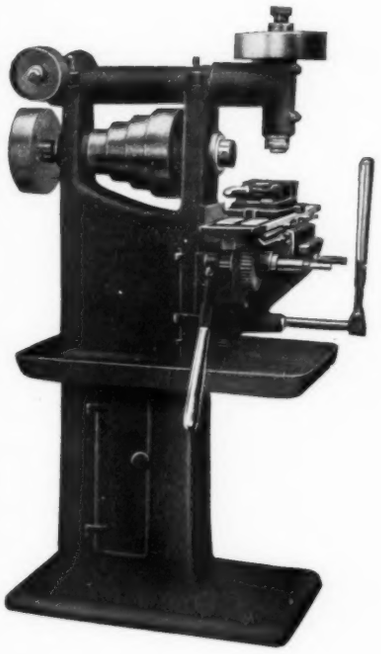

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Hand Milling Machine

The Vertical Spindle is valuable for a great variety of purposes. We recently sold one to a large brass manufacturer for making brass patterns, and it has proved a great labor-saver. Send for new catalog showing various operations that can be performed on this machine.

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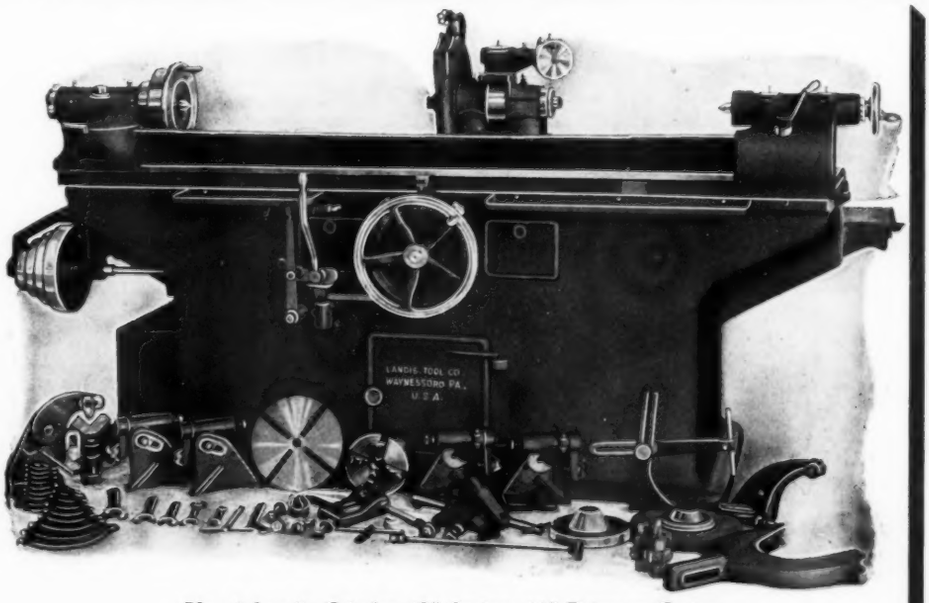
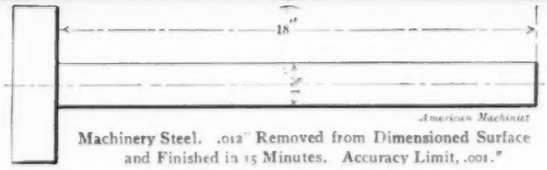


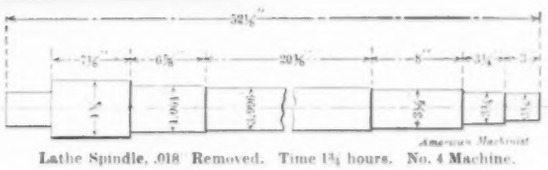
No. 4 Landis Grinder, 12" Swing, 66" Between Centers.

Landis Grinders Always Grind Out A Profit.

They come up to the scratch where other grinders fall down. They have the most generous provision for water and plenty of weight to resist vibration. Built throughout in a modern, painstaking way. You're bound to buy a grinder some day and you might as well get the best and get it now. Send for our literature to-day. It's the advance agent of prosperity that comes along with Landis Grinders.



Machinery Steel. .012" Removed from Dimensioned Surface and Finished in 15 Minutes. Accuracy Limit, .001."



Lathe Spindle, .018 Removed. Time 1¾ hours. No. 4 Machine.

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Nicholson File Co., Provi., R. I.

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Winkley Co., The, Hartford, Conn.

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Canton Fillet Co., Canton, O.

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Coates Clipper Mfg. Co., Worcester, Mass.

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Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

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Billings & Spencer Co., Hartford, Conn.
Lang Co., G. R., Cincinnati, O.
Solid Steel Tool & Forge Co., Pittsburg, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Crucible Steel Forge Co., Cleveland, O.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

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Paxson Co., J. W., Phila., Pa.

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Obermayer Co., S., Cincinnati, O.
Rockwell Engineering Co., Jersey City, N. J.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Rockwell Engineering Co., Jersey City, N. J.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Meisel Press & Mfg. Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

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Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.

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Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Whiton Machine Co., D. E., New London, Conn.

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Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Gear Works, Cleve., O.
Cresson Co., Geo. V., Phila., Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foster-Kimball Mach. Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Meisel Press & Mfg. Co., Boston, Mass.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor, Wilson & Co., Allegheny, Pa.

Gears, Rawhide
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mch. Co., Phila., Pa.
Fawcus Machine Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.

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Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.

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Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Iroquois Mach. Co., New York.
Ney, R. W., Pine Plains, N. Y.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

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Besly & Co., Chas. H., Chicago, Ill.
Blount & Co., J. G., Everett, Mass.
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Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Ney, R. W., Pine Plains, N. Y.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Co., J. R., New York.
Vitrified Wheel Co., Westfield, Mass.
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Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Hampden Cor. Wheel Co., Brightwood, Mass.
Niles-Bement-Pond Co., New York.
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Billings & Spencer Co., Hartford, Conn.
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Merrill Bros., Brooklyn, N. Y.
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Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.

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Cleveland Pneumatic Tool Co., Cleveland, O.
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Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

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Niles-Bement-Pond Co., New York.
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Link Belt Engineering Co., Philadelphia, Pa.
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C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, Ohio.
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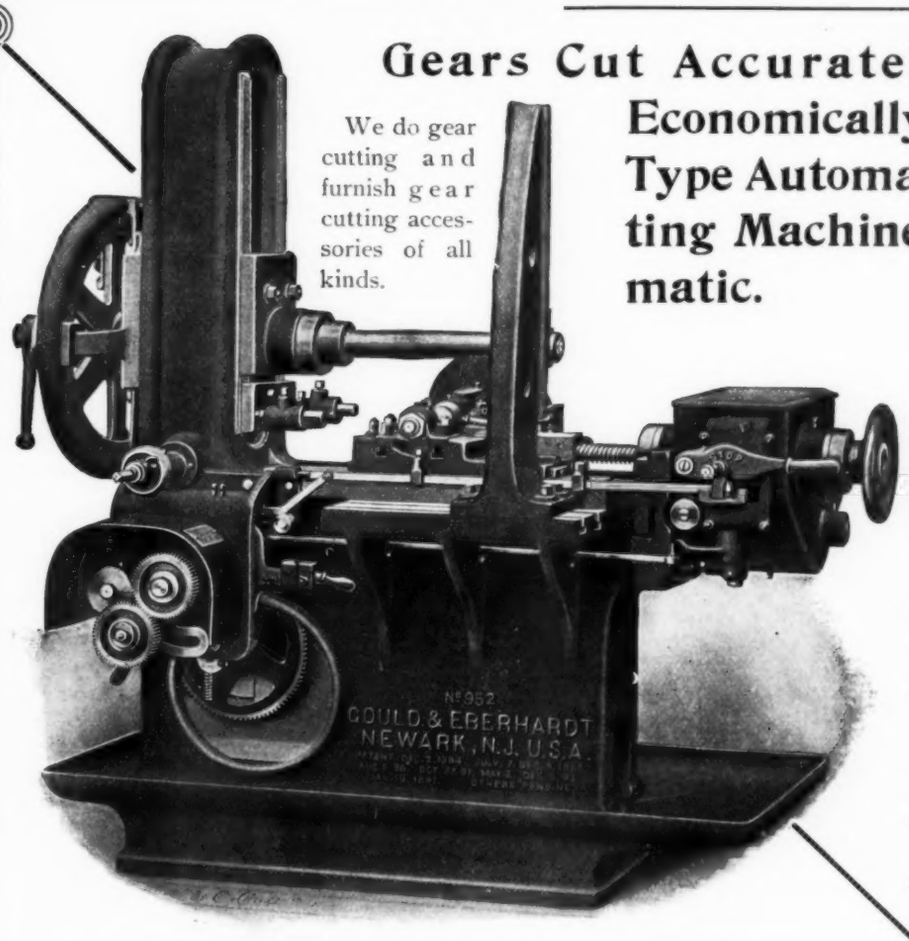

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They need no attention after being set until the gear is completed.

Accurate Worm Dividing Wheel, made in sections.

Powerful screw feed to cutter slide.

Cutter spindle driven by powerful, smooth-running worm and worm wheel.

Movable outside support to work arbor.

Patented oil pan base prevents oil soaked floors.

Many other features and full details on request.

Made in 16 styles and sizes, 12" to 12' capacity.

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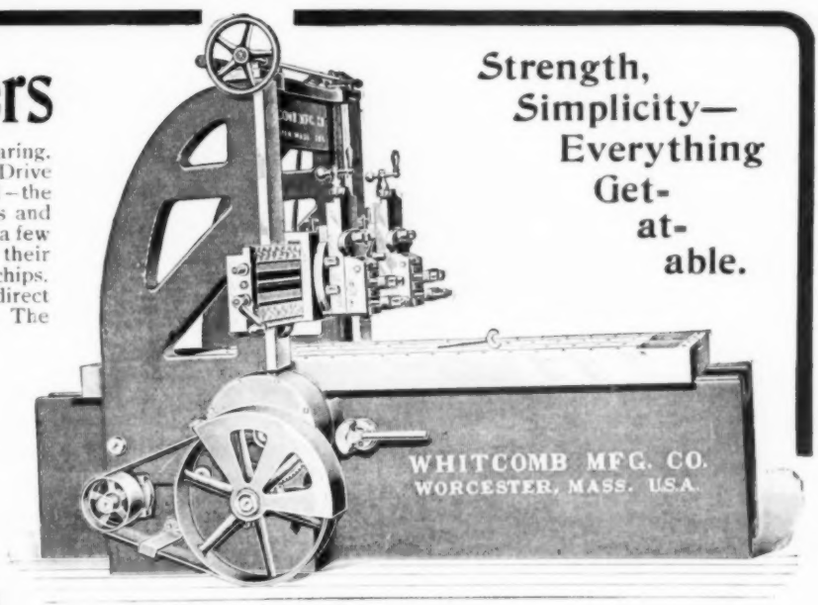

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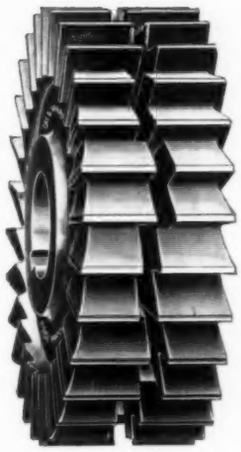

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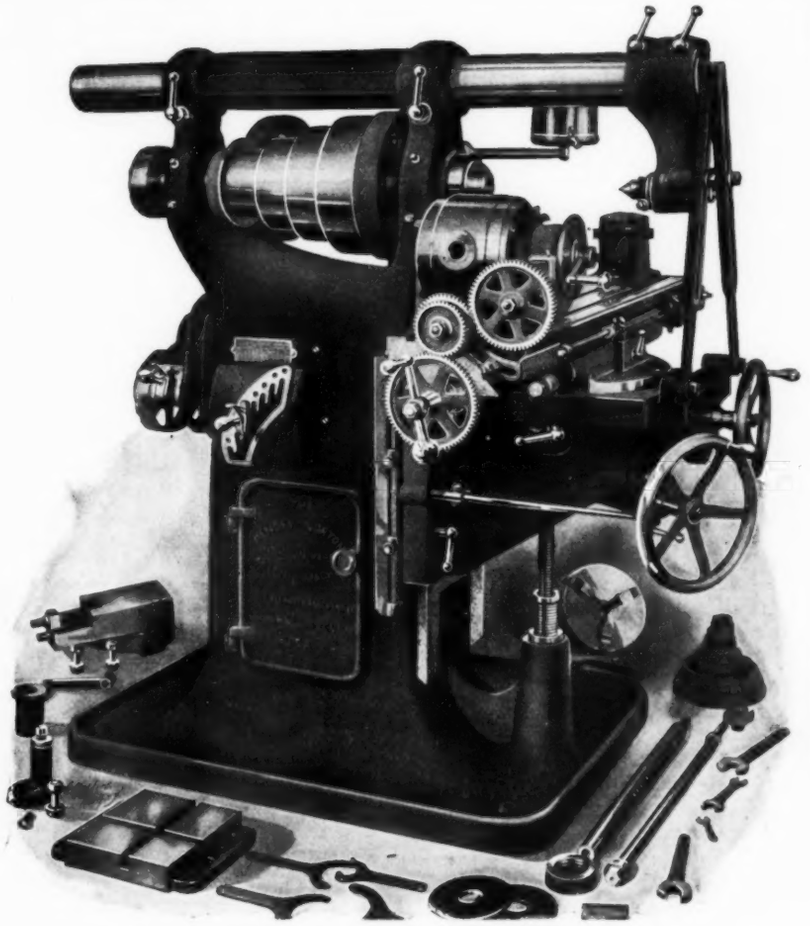
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.



HENDEY-NORTON

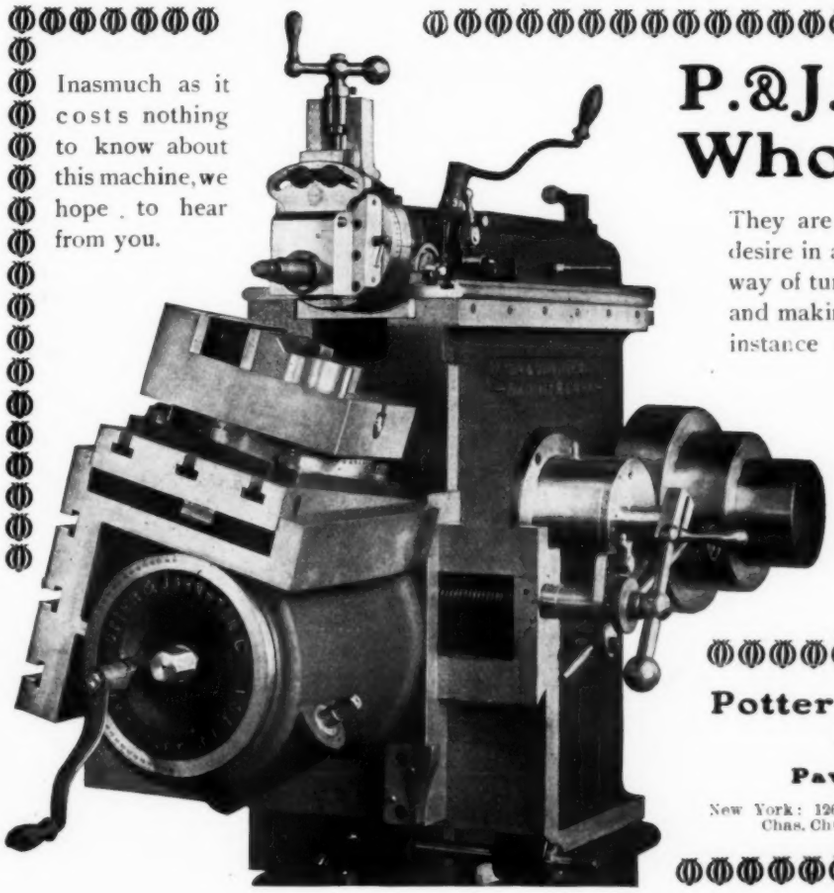
MILLERS.

No. 3 Universal Miller. All feeds automatic. Micrometer adjustment for feed trips. Taper-bearing self-oiling spindle. Working Surface of Table, 46½ x 10½. Range of Feeds, 30x8x18½. Capacity of Centers, 12″x27″. May be furnished with roller chain drive.

...THE...
HENDEY MACHINE CO.,
TORRINGTON, CONN., U.S.A.

Manning, Maxwell & Moore, General Agents.
The J. W. Cregar Agency, Philadelphia. }
The W. M. Pattison Mach'y Co., Cleveland. } Special Agents.
Thomas & Lowe Mach'y Co., Providence. }

Inasmuch as it costs nothing to know about this machine, we hope to hear from you.



P.&J. Shapers Are Wholly Good

They are a composite of everything you could desire in a shaper, and as a result have a pleasing way of turning out work profitably. The design and making has been to this end alone. As an instance of convenience there is the swiveling table with tilting head; this allows for the completion of several operations at one setting of the work, which saves time and insures closer accuracy. This single feature will serve to point the value of the many others, all of which have description in special bulletins.

Potter & Johnston Machine Company,
Pawtucket, R. I., U.S.A.

New York: 126 Liberty Street, Walter H. Foster, Manager.
Chas. Churchill & Co., Agts. for England, London.

Screws, Machine
Cincinnati Screw & Tap Co., Cincinnati, O.
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.
Worcester Mach. Screw Co., Worcester, Mass.

Second Hand Machinery
Baird Machy. Co., Pittsburg, Pa.
Baush, W. H., Springfield, Mass.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschardt Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Cresson Co., Geo. V., Phila., Pa.
Sawyer, Ezra, Worcester, Mass.

Separators, Steam
Nicholson & Co., W. H., Wilkesbarre, Pa.

Shafting
Brightman Mfg. Co., Shelby, O.
Cresson Co., Geo. V., Phila., Pa.
Cumberland Steel Co., Cumberland, Md.
Niles-Bement-Pond Co., New York.
Union Drawn Steel Co., New York.

Shapers
American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincinnati, O.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Smith & Mills, Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Steptoe Shaper Co., John, Cincinnati, O.
Vandyck Co., J. R., New York.

Shapers, Vertical Die
Rochester Die Shaper Co., Rochester, N. Y.

Shear Knives, Solid Steel
Heppenstall Forge & Knife Co., Pittsburg, Pa.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Royersford Fdry. & Mach. Co., Royersford, Pa.

Shears, Rotary
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., Warren, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Betts Mach. Co., Wilmington, Del.
Dill Machine Works, T. C., Philadelphia, Pa.
Garvin Mach. Co., New York.

Slotters—*Continued*
National-Acme Mfg. Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Speed Changing Countershaft
Cresson Co., Geo. V., Phila., Pa.
National Mach. Tool Co., Cin., O.
Power & Speed Controller Co., Boston, Mass.
Reeves Pulley Co., Columbus, Ind.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.
Globe Mach. & Stamping Co., Cleveland, O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Fittings
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel, Machinery
Colonial Steel Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Union Drawn Steel Co., New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Colonial Steel Co., Pittsburg, Pa.
Federal Mfg. Co., Cleveland, O.
Union Drawn Steel Co., New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Colonial Steel Co., Pittsburg, Pa.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Union Drawn Steel Co., New York.
Ward & Son, Edgar T., Boston, Mass.

Straightener, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Straightening Machinery
Brightman Mfg. Co., Shelby, O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Burke Mchy. Co., Cleveland, O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.

Taps and Dies—*Continued*
Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reece Co., E. F., Greenfield, Mass.
Standard Tool Co., Cleveland, O.
Superior Tap Co., Springfield, Vt.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Telephones, Interior
Holtzer-Cabot Elec. Co., Brookline, Mass.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Tools, Small
See Machinists' Small Tools.

Tracing Cloth
Keuffel & Esser Co., New York.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Power & Speed Controller Co., Boston, Mass.
Reeves Pulley Co., Columbus, Ind.
Standard Pressed Steel Co., Philadelphia, Pa.

Trimmers, Wood
Oliver Mchry. Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Turret Machines
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Bogert, John L., Flushing, L. I., N. Y.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Foster Co., Walter H., New York.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.

Turret Machines—*Continued*
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Detroit Twist Drill Co., Detroit, Mich.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., C veland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Gould & Eberhardt, Newark N. J.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.
Nolte Brass Co., Springfield, O.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Meadville Vise Co., Meadville, Pa.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Meadville Vise Co., Meadville, Pa.
Saunders' Sons, D., Yonkers, N. Y.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Meadville Vise Co., Meadville, Pa.
Niles-Bement-Pond Co., New York.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Meadville Vise Co., Meadville, Pa.
Wyman & Gordon, Worcester, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Vaughn, Turner & Taylor Co., Cuyahoga Falls, O.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Oliver Mchy. Co., Grand Rapids, Mich.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.
Greene, Tweed & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.